A STUDY ON QUALITY IMPROVEMENT PRACTICES IN HONG KONG INDUSTRY

by

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Abstract

This paper presents the first empirical study on a holistic Total Quality Management model. The model integrates the seven Malcolm Baldrige National Quality Award criteria, organizational quality contextual variables and financial performance measures. Structural equation modeling was applied to confirm the theoretical causal ordering, using data collected from 401 Hong Kong companies. Most of the constructs were found to be reliable and valid. The results have provided strong empirical confirmation for the holistic Total Quality Management model, with all the hypothesized theoretical relationships supported.

Researchers can use this model as a basis for further empirical work aiming at increasing the generalizability of the findings and refining the formulation of the model. Managers can adopt the findings for successful implementation of Total Quality Management which contributes to better quality results, higher customer satisfaction, and ultimately more competitive financial performance.

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PREFACE

This study is dedicated to all who are devoted to continuous quality improvement in Hong Kong. It is my sincere wish that this study will provide benefits to both the academic research and industrial development. Through identification of the characteristics of quality improvement practices in Hong Kong, I hope that Hong Kong companies can share the successful factors of the quality leaders in their industries. The findings of this study will also serve as a confirmatory study to previous quality related works and an empirical evidence to encourage Hong Kong managers to pursue better quality and higher productivity. This, I hope, will be my modest contribution to the prosperity of Hong Kong.

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As always, I retain responsibility for all errors and would greatly appreciate any comments on this thesis.

CHAPTER I

INTRODUCTION

In order to compete and survive in the competitive global marketplace, firms have to offer the highest quality products (Garvin 1987), services (Parasuraman et al. 1985), and processes (Misterek et al. 1990) to satisfy the increasing customer expectations. More and more organizations have recognized the importance of quality and used quality management as a strategic weapon to enhance their competitive advantages (Buzzell & Gale 1987). From top management's strategic use of quality, to applications of quality improvement techniques in operational systems, to marketing's concerns with customer satisfaction, quality has been given the top priority (Peterson 1991). But what are the important factors for successful quality management and how are these factors related?

Much has been written on the concepts of quality management and the outcome effectiveness of quality improvement practices. These issues focus on reducing costly mistakes, emphasizing preventive approaches, and

management participation (Crosby 1979,1984; Deming 1986; Garvin 1988; Juran 1982,1989). On the other hand, empirical studies to examine the implementation of quality management practices and validity of the theory have not been researched thoroughly. It has been revealed that out of the 226 published Total Quality Management (TQM) literature from 1970 to 1993, only 29 are empirical studies (Ahire et al. 1995). This is consistent with the fact that TQM has been recognized only recently by industries as a powerful competitive strategy (Madu & Kuei, 1993).

Moreover, most of the articles on these studies lacked generalizability to verify the theoretical TQM framework. Doran (1985), Ham & Williams (1986), and Newall & Dale (1991) presented case studies on six of the seven Malcolm Baldrige National Quality Award (MBNQA) criteria, but none examined all the seven criteria together. Saraph et al. (1989) identified broad categories of critical factors of quality management, but the relationships among those factors were not explored. So far, there has been no published research that covers all the MBNQA criteria comprehensively and specifies the causal relationships among the criteria. In fact, TQM applications have preceded the theoretical framework, as

in the case of quality circle (Griffin, 1988). An extensive empirical study is required to examine the implementation and effectiveness of TQM practices in real business setting.

This paper demonstrates the first attempt to examine a holistic TQM framework using the seven MBNQA criteria jointly: Leadership, Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, Management of Process Quality, Quality & Operational Results, Customer Focus & Satisfaction. In addition, the four significant factors of the organizational quality context identified by Benson et al. (1991), namely, Managerial Knowledge, Corporate Support for Quality, Past Quality Performance, and Marketplace Environment, were introduced to relate environmental issues and organization policies to the category of Leadership. The relationships among TQM practices and traditional measures of financial performance were also studied to explore the effectiveness of TQM practices.

Eight hypotheses were proposed to specify the causal relationships among the constructs of the organizational quality context, the seven MBNQA criteria, and Financial Performance. Using databases from several industrial

associations, an extensive survey was conducted and 401 questionnaires were used to provide data for empirical evidence. Construct reliability, convergent validity and discriminant validity were tested before analysis of structural equation modeling to ensure that the constructs were both reliable and valid measures. Confirmatory factor analysis was undertaken to identify the crucial items associated with each of the constructs. Structural model was then applied to confirm the causal ordering among the constructs based on existing literature. The results show that the model fits the data set adequately and the statistical significance of hypotheses supports the theoretical causal relationships.

In terms of academic research, this paper provides empirical confirmation to the proposed holistic TQM model. Researchers can use the model as a basis for further empirical work aiming at increasing the generalizability of the findings and refining the formulation of the model. From the practical standpoint, managers could use the measurement items identified in this study to make better decisions in identifying and evaluating status of implementation of quality programs. The findings of causal relationships among the TQM constructs help managers to prioritize improvement

efforts in various quality areas in order to achieve the desired objectives such as better quality results, higher customer satisfaction and more competitive financial performance.

This paper begins with a literature review based on several well-established quality management frameworks to better understand what constructs and measurements should be selected for the research model. Secondly, the hypotheses of the research will be stated to investigate how and why the selected constructs are interrelated. The research design and the sample characteristics will then be described. Fourthly, statistical analyses of the model are examined for a discussion of the results and implications. Finally, recommendations for future research directions will be given.

CHAPTER II

LITERATURE REVIEW

A review on quality management literature will be given in this chapter. Definitions of some key terms will be provided in the first place. A comparison of the quality management approaches proposed by the leading quality gurus, namely, Deming, Juran, and Crosby, will be made to identify the important approaches of quality management. It is then followed by an evaluation of the three popular quality management framework: International Quality Standards (ISO 9000 series), the Deming Prize, and the MBNQA, using the coverage of various important TQM practices as selection criteria.

Definitions of Terms

Definition of Quality

The term *quality* has several definitions. According to ANSI/ASQC standard A3-1987, "quality is the totality of features and characteristics of a product or service that bear on its ability to satisfy implied or stated

needs." The features and characteristics are best explained by Garvin's (1987) eight principal quality dimensions, that is, performance, features, reliability, conformance, durability, serviceability, aesthetics, and perceived quality. Recently, a more converging view has focused quality on the production and design/marketing aspects (Roth & Giffi 1994). The production viewpoint defines quality as conformance to specification, whereas the design/marketing viewpoint defines it as the value perceived and fitness for use. The important characteristics of a product or service are determined by specific market goal and specific technical requirements of the conversion process. The product or service is designed to match the market goal while the process capability must minimize the deviation between the output characteristics and the specifications. This definition of quality is consistent with the measurement items in the critical factor of Product/Service Design in Saraph et al. (1989).

Definition of Total Quality Management

Total Quality Management (TQM) is "an integrative management philosophy aimed at continuously improving the quality of products, services, and processes to achieve

customer satisfaction" (Ahire et al. 1995). It is the responsibility of everyone in the organization to make quality a concern and direct improvement towards higher customer satisfaction.

The Quality Forum in 1992 provided a more precise definition of *Total Quality* as follows (A Report of the Total Quality Leadership Steering Committee and Working Councils, 1992):

> "Total Quality is a people-focused management system that aims at continual increase of customer satisfaction at continually lower real cost. Total quality is a total system approach (not a separate area or program), and an integral part of high-level strategy; it works horizontally across all functions and departments, involves all employees, top to bottom, and extends backwards and forwards to include the supply chain and the customer chain."

Judging from the above definitions, we can conclude that the foundation of TQM philosophy is composed of three major concepts: customer focus, total participation, and continuous improvement.

There is by far no universal definition of TQM. The definition given by the Quality Forum only provides a basic framework for reference. However, the scope and detailed descriptions of TQM may be better understand by comparing the quality management approaches of Deming, Juran, and Crosby in a systematic way.

Comparison of Quality Management Approaches of Deming, Juran, and Crosby

Deming's Approach to Quality Management

Deming is regarded as the top leader who contributed most to the Japanese quality revolution. He approached quality management from a statistician's perspective, using statistical process control (SPC) and other problem-solving techniques to measure process performance. He identified process variation into common causes, which were systematic variation arisen from machines, materials, and operators, as well as special causes relating to sudden changes in product quality due to mistakes. Deming stressed that it was the responsibility of top management to solve most of the quality problems (85%). He proposed his 14 points (Deming 1986) as guidelines for management to create an

organizational environment for effective implementation of quality management. These included top management commitment to quality, enhancing communication between employees and departments, providing training and supervision, encouraging employee participation, focusing on quality rather than price, and creating consistent purpose of continuous improvement. These points are summarized in Table 1.

Juran's Approach to Quality Management

Juran is also considered as one of the early leaders in the quality field. He defined quality as the "fitness for purpose" and "fitness for use". Juran emphasized the importance of quality in every step of the product development cycle and along the value chain from design, to manufacturing, and finally to delivery and maintenance service. Juran identified the four major categories of costs of quality as internal failure costs, external failure costs, appraisal costs, and preventive costs. He argued that "zero detects" was not practical and proposed that an "optimal" quality level could be achieved by breakthrough projects, control sequence, and annual quality programs. Table 1 shows the salient features of Juran's approaches.

Crosby's Approach to Quality Management

Crosby gave a different definition of quality from that of Juran. In his "Four Absolutes of Quality Management" (Crosby 1979), he defined quality in a production viewpoint as "conformance to specification". In contrast to Juran's "optimal" quality level, Crosby emphasized prevention to achieve "zero defects", a core concept from which his 14-step zero defects program was derived. He argued that "quality is free" because an improvement in quality lowered the costs, hence increased profitability (Crosby 1979). Crosby also held a different view from Deming in terms of employee motivation, recognition, and reward. Table 1 illustrates the detail tools to accomplish the zero defects objective.

The different approaches to quality management suggested by the quality gurus can in fact be summarized into several key concepts as follows:

1) Recognizing the essence of top management commitment;

2) Creating an organization climate and culture that support the implementation of quality;

3) Devoting efforts in improving the processes rather than products;

4) Training and educating employees, encouraging employee participation and teamwork;

5) Emphasizing on prevention rather than inspection in reducing costs of quality;

6) Involving every employee and every department in the company-wide activity of TQM.

Evaluation of Quality Management Frameworks

International Quality Standards

The ISO 9000 series consist of five international standards for quality management. ISO 9000 provides concepts, definitions, and an overview of selection of ISO 9001, 9002, and 9003, the details of which are stated as follows (International Organization for Standardization 1994):

ISO 9001: Quality system model for a contract requiring supplier capability of design/development, production, inspection, testing, training, installation, and servicing;

ISO 9002: Quality system model for a contract requiring supplier capability of production, inspection, testing, training, installation, and servicing;

ISO 9003: Quality system model for a contract requiring supplier capability of inspection, testing, and training.

It should be noted that there was a revision of the ISO 9000 series in 1994. The coverage of ISO 9002 has been extended to include servicing and the coverage of ISO 9003 has been greatly extended beyond final inspection and test for a number of clauses. A comparison of the coverage of the 1994 revised versions of ISO 9001, ISO 9002, and ISO 9003 is depicted in Table 2.

ISO 9004 is composed of 2 parts. Part 1 reviews quality management standards providing guidelines and recommendations for the development and implementation of an effective quality system. Part 2 provides service organization standards of policy and objective, system management, human resource, and documentation.

Today, ISO 9000 series are well adopted by the European Community and the American National Standards Institute as the basis for contracting. Certifiers of ISO 9000 enjoy the benefits of facilitated trading and simplified contracting in over 100 countries under the associations.

The Deming Prize

The Deming Prize, in recognition of Deming's contribution to Japan quality leadership, is the highest prestigious award in Japan. Its purpose is to award those companies having applied Company-Wide Quality Control (CWQC) based on statistical process control. The award criteria examine the implementation of the organization quality policy, education, use and analysis of quality information, controlling and quality assurance, results (cost and performance), and future vision.

ISO 9000 series focus mainly on documentation and assurance of the quality system. On the other hand, the Deming prize demands management vision, and more importantly, results as well. The award allocates 60 percent of the scores to process management and 40 percent to result. The use of statistical process control, which is the fundamental tool to reduce process variation and to improve quality, is heavily emphasized in the process. Companies should also devote effort to empower employees in mastering various quality improvement techniques. The Deming prize does evaluate results and performance not examined in ISO 9000 to

assess the accomplishment of the company in attaining world class leader.

The Malcolm Baldrige National Quality Award

The MBNQA has become the most popular guideline for the implementation of quality system (Garvin 1991). The award was established by the Malcolm Baldrige National Quality Improvement Act of 1987 to recognize U.S. organizations that have superior quality management and related performance criteria. The purposes of the Award are as follows (NIST 1993):

"1) To help elevate quality standards and expectations;

2) To facilitate communication and sharing among and within organizations of all types on a common understanding of key quality requirements;

3) To serve as a working tool for planning, training, assessing, and other uses."

Applicants of the award are evaluated against the performance of the seven MBNQA criteria. These are Leadership, Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, Management of Process Quality, Quality & Operational Results, and Customer Focus & Satisfaction.

Accordingly, these seven categories can be further grouped into four main elements (NIST 1993).

1) Driver: The leadership of senior executives creates the values, goals, and systems and guide the sustained pursuits of quality and performance objectives.

2) System: It comprises the set of well-defined and well-designed processes, namely, Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, and Management of Process Quality, to meet customer and performance requirements.

3) Measures of progress: The performance measures provide a result-oriented basis for channeling actions towards delivering ever-improving customer value and company performance.

4) Goal: The basic aim of the system is to deliver ever-improving value to customers in order to achieve strategic objectives.

Table 3 lists the detailed 28 items, with individual scoring weights, associated with the seven categories. As shown in the scoring weight, there is a remarkable difference in the relative importance of the seven categories. Customer Focus & Satisfaction is given the top priority and accounts for 30 percent of the total score. Other important categories emphasized by the

Award are Quality & Operational Results (18 percent), Human Resources Development & Management (15 percent), and Management of Process Quality (14 percent).

Selection of Quality Management Framework

In this section, a contrast of the three popular quality management framework, that is, ISO 9000, the Deming's Prize, and the MBNQA, will be discussed in terms of the coverage in the major critical quality areas as proposed by the quality gurus.

The officials of NIST pointed out that "many people are confused between the MBNQA and ISO 9000, resulting in two common misperceptions that they cover the same requirements and they focus on improvement, both being forms of recognition and relying on high quality results. These misperceptions lead people to conclude that the choice of one or the other makes no difference. The MBNQA and ISO 9000, in fact, differ significantly in focus, purpose, and coverage." (Reimann & Hertz, 1994)

The focus of MBNQA is customer satisfaction which carries the heaviest scoring weight (30 percent) in the overall criteria. Successful applicants must show that they have implemented quality systems which continuously

deliver ever-improving values to customers. Results such as quality and supplier performance are also emphasized as key indicators to achieve competitiveness. On the other hand, ISO 9000 focuses on conformance to practices and operations specified in a certifer's own documented quality system. The assumption is that consistent practices in specified operations and proper documentation will assure the quality of outputs as stated in the contract. Becoming ISO-certified, however, does not imply that the company has produced high quality products, improved competitiveness, or improved customer satisfaction.

The purpose of the MBNQA is to promote quality awareness, recognize quality achievements of successful U.S. Companies, and encourage the sharing of competitive quality strategies to drive the national knowledge on quality. Whereas ISO 9000 only serves as a way to enhance and facilitate trade among member countries.

Most of the core values and concepts stressed in the MBNQA are not addressed in ISO 9000. These include customer-driven quality, continuous improvement, result orientation, full participation, fast response, partnership development (particularly with suppliers), and future orientation. Overall, "ISO 9000 covers less

than 10 percent of the scope of the MBNQA criteria and does not fully address any of the 28 criteria items in the seven MBNQA categories." (Reimann & Hertz 1994)

From the above comparison, it can be concluded that ISO 9000 only establishes the conformance requirements which provide the foundation and prerequisite for building towards a more comprehensive TQM. Therefore, ISO 9000 will not be considered as the framework for our TQM model.

The coverage of the Deming Prize is comparable to that of the MBNQA. Both of them provide elaborated criteria for top management leadership, quality information, human resources utilization, and process management, all of which are critical factors identified in Saraph et al.'s work (1989). In spite of similar coverage, the Deming Prize and the MBNQA focus on different aspects. The former emphasizes on using statistical process control as the improvement tool whereas the latter aims at delivering ever-improving value for higher customer satisfaction. It is believed that the customer-oriented approach is more effective than the process improvement approach in gaining market share and customer retention (Buzzell et al. 1981).

The MBNQA is also superior to the Deming Prize since it provides a framework for the causal relationships among the seven categories. Moreover, the importance of each category in the MBNQA can be ranked according to the scoring weight which is not addressed in the Deming Prize. The extensive coverage of the MBNQA, together with the scoring system, "has succeeded in serving the objective of providing a comprehensive framework for measuring quality efforts beyond expectations." (Garvin 1991)

To sum up, ISO 9000 can only be used as a fundamental building block for the more comprehensive TQM. The Deming Prize has sufficient coverage in the major quality areas but it lacks a conceptual model to specify the relationships among those factors. Only the MBNQA serves well as a reference framework to examine a comprehensive TQM model. In fact, the MBNQA criteria have been suggested for setting research agenda by the Total Quality Leadership Steering Committee (1992).

Past Research on the Malcolm Baldrige National Quality Award Criteria

Table 4 summarizes the past quality management literature from 1970 to 1993 (Ahire et al. 1995). It is

revealed that most of the published TQM research has emphasized on conceptual issues (107 articles), followed by case studies (56 articles). On the other hand, empirical studies (29 articles) to examine the implementation of quality management practices and validity of the theory have not researched thoroughly. Using the MBNQA as the basis for categorizing past TQM literature, it is found that there has been no published research that examines all the seven MBNQA criteria comprehensively (Ahire et al. 1995).

Doran (1985), Ham & Williams (1986), and Newall & Dale (1991) presented detailed case studies on six of the Malcolm Baldrige National Quality Award (MBNQA) criteria, but generalization of the findings in case studies may not be possible.

For empirical work, Kowalski & Walley (1993) examined the relationships among human resource management, production process, quality result, and customer satisfaction. Lascelles & Dale (1990) and Saraph et al. (1989) successfully identified the key issues and critical factors of quality management, but the relationships among those factors were not addressed. Flynn et al. (1995) developed a path analytical TQM model which described core and infrastructure quality

management practices and their relationships to quality and plant performance. The exploratory model, however, was not built on well-established TQM framework such as the MBNQA. Moreover, the influence of the organizational quality context on top management and the effectiveness of quality management practices on financial performance were not studied. To fill the deficiency in empirical literature, a research that provides empirical validation of the causal relationships among the seven MBNQA criteria should be undertaken.

CHAPTER III

THE CONCEPTUAL RESEARCH MODEL AND RESEARCH HYPOTHESIS

The Conceptual Research Model

Based on an extensive literature review, a holistic model was developed to operationalize the conceptual constructs of TQM and to specify the causal relationships among those constructs. The path diagram, as shown in Figure 1, consists of the 12 conceptual constructs including the organizational quality context, the MBNQA criteria, and financial performance.

The MBNQA attributes seven constructs: Leadership, Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, Management of Process Quality, Quality & Operational Results, and Customer Focus & Satisfaction. These criteria provide a comprehensive coverage of measurements of TQM practices.

Benson et al. (1991) identified four significant organizational quality contextual variables, namely, Managerial Knowledge, Corporate Support for Quality, Past Quality Performance, and Marketplace Environment. These were incorporated in the model to study the impact of the

organizational quality context on leadership role and effectiveness.

The construct of Financial Performance is not a MBNQA criterion, but it provides an objective measure of the effectiveness of various TQM practices. After all, the ultimate goal of implementing TQM is to attain greater financial return. Customer satisfaction is only the strategic objective in achieving the goal.

The 12 constructs can be categorized into four main elements, as shown by the dotted rectangular blocks in the path diagram, in term of causal ordering of the framework. Stimulated by the organizational quality context, top management acts as the driver of TQM implementation in the operational system, which, when implemented, achieves more competitive performance results. The detailed causal relationships among the constructs are represented by the arrows in the path diagram. A direct effect in the form of uni-directional arrow is shown as a path pointing from the independent variable (cause) to the dependent variable (effect). An indirect effect is represented by a series of forward-pointing arrows joining two variables via other mediating variables. For example, the direct effect of Leadership on Human Resource Development & Management is indicated

by the path $P_{\eta 4 \eta 1}$. Leadership can also exert indirect effects on Human Resource Development & Management, going through the composite of path $P_{\eta 2 \eta 1} \rightarrow P_{\eta 3 \eta 2} \rightarrow P_{\eta 4 \eta 3}$ and $P_{\eta 3 \eta 1} \rightarrow P_{\eta 4 \eta 3}$. The justification of the specified causal relationships will be discussed in the following section.

Research Hypothesis

Based on well-established theoretical consideration and knowledge on quality management literature, eight hypotheses are proposed to test the specified causal relationships among the constructs.

Hypothesis 1: Organizational quality context, including Managerial Knowledge, Corporate Support for Quality, Past Quality Performance, and Marketplace Environment, has a direct and positive influence on Leadership.

Top management's views of both actual and ideal quality management are influenced by their organizational quality contexts (Benson et al. 1991), which in turn stimulate top management to evaluate any significant discrepancies in their organizations (Kiesler & Sproull 1982). Therefore, such quality contexts help top

management identify problems and develop strategic decisions to achieve the established goals (Smith, 1988).

Hypothesis 2a: Leadership has a direct and positive influence on Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, and Management of Process Quality.

Hypothesis 2b: Leadership has an indirect and positive influence on Quality & Operational Results, and Customer Focus & Satisfaction mediated by the operational system.

Top management acts as the driver of TQM implementation. It creates and sustains clear and visible customer-focused quality values which are integrated into the operational system. Senior management must change from the reactive role to the proactive role of leadership, governing policies, strategies and translating them into quality planning and deployment functions (Lascelles & Dale 1989b). Tregoe (1983) pointed out the influential role of leadership in strategic quality planning, human resource development, and process management. Improvement in these operational processes, triggered off by senior management's emphasis on result-oriented goal and customer focus, will drive

the organization towards competitive excellence and beyond customer expectations (Ham & William 1986).

Hypothesis 3a: Information & Analysis has a direct and positive influence on Strategic Quality Planning.

Hypothesis 3b: Information & Analysis has an indirect and positive influence on Human Resource Development & Management, Management of Process Quality, Quality & Operational Results, and Customer Focus & Satisfaction.

Information & Analysis is addressed in the MBNQA as the scope, validity, management, and use of data and information in quality planning to drive quality excellence and improve competitive performance. Thus, it is explicitly stated in the MBNQA criteria that fast, accurate and adequate information will help decision makers arrive at a better quality plans decisions. Babbar (1992) developed a dynamic model to demonstrate the role of information and analysis in assisting quality planning and other strategic decisions. Improvement in decision making in strategic quality planning will in turn direct an organization's resources to achieve competitive performance in the operational system, quality results, and customer satisfaction. In fact, the

evolution of information technology has changed the tactical function of information management to the strategic weapon of quality assurance (Willborn 1986). Miller (1992) discussed the benefit of using real-time data in attaining higher customer satisfaction through immediate availability of accurate and reliable information for planning and decision making.

Hypothesis 4a: Strategic Quality Planning has a direct and positive influence on Human Resources Development & Management, and Management of Process Quality.

Hypothesis 4b: Strategic Quality Planning has an indirect and positive influence on Quality & Operational Results, and Customer Focus & Satisfaction.

According to the MBNQA, the category of Strategic Quality Planning examines the adequacy of strategic deployment, strategy formulation, and integration of key quality requirements into the overall business planning. Strategy deployment is to translate the desired competitive quality strengths into activities such as human resource management and quality assurance in design and manufacturing. Juran (1978) and Hayes (1981) evidenced the relationship between strategic deployment

functions in human resource and process management in Japanese factories. By integrating key quality dimensions into strategic formulation, companies can plan and organize their resources to attain better results and fulfill customer requirements (Belohlav 1993). Wacker (1989) developed an analytical model to show the indirect effect of strategic quality planning on higher customer satisfaction.

Hypothesis 5a: Human Resource Development & Management has a direct and positive influence on Management of Process Quality and Quality & Operational Results.

Hypothesis 5b: Human Resource Development & Management has an indirect and positive influence on Customer Focus & Satisfaction.

In Human Resource Development & Management, the extent to which the workforce develops its full potential to pursue the organization's quality and operational performance objectives is assessed in the Award. The effort to build and maintain an environment for quality excellence conducive to full participation, personal and organizational growth is also considered. Fisher (1992) presented a case study to demonstrate how employees

trained and educated with TQM practices improve productivity and performance of the operational system. Roth & Miller (1992) empirically identified training and development of employees as a strategic successful factor for both process improvement and quality excellence. This relationship was further justified by Juran's (1981a, 1981b) philosophy of using quality circle as techniques to improve quality and productivity. Kowalski & Walley (1993) and Harber et al. (1993a) provided empirical evidence for the indirect impact of an effective human resource on customer satisfaction.

Hypothesis 6a: Management of Process Quality has a direct and positive influence on Quality & Operational Results.

Hypothesis 6b: Management of Process Quality has an indirect and positive influence on Customer Focus & Satisfaction.

The MBNQA evaluates the systematic processes used to pursue ever-higher quality and company performance. In fact, process improvement is a key focus in TQM and there is a consistent belief that the quality of products and services can be enhanced through improvement in process management. Deming (1986) emphasized the use of

statistical process control to improve product quality. Stein (1991) discussed the effectiveness of using statistical process control to monitor conformance and reduce costs of quality. Garvin (1983) and Ishikawa (1976) pointed out that higher quality could be achieved by identifying the problems in production processes to ensure smooth production schedules. Empirically, positive relationships between certain critical factors of process management and performance results were observed in manufacturing industry (Roth & Miller 1992). Management of Process Quality in MBNQA also covers other supportive functions like design, marketing, and supplier management. By incorporating market goal into product design and development, companies can produce products which have "high value and fitness for use" (Roth & Giffi, 1994). Design engineers need to identify and translate the important product attributes perceived by customers into product design and development. The relationship between process management and customer expectation was also investigated in Wacker's (1989) analytical model.

Hypothesis 7: Quality & Operational Result has a direct and positive influence on Customer Focus & Satisfaction and Financial Performance.

Hypothesis 8: Customer Focus & Satisfaction has a direct and positive influence on Financial Performance.

The relationships among Quality & Operational Results, Customer Focus & Satisfaction, and Financial Performance are best illustrated by the Deming Chain Reaction (Deming 1982) and the Garvin's Cost Savings Model (Garvin 1984a). The Deming Chain Reaction, as shown in Figure 2, demonstrates that improvement in quality lowers production costs and improves productivity, hence increases market share and return on investment. The Garvin's Cost Savings Model, as shown in Figure 3, illustrates that improvement in quality leads to greater return on investment in two different ways that are consistent with the production and marketing viewpoints of quality. In the production viewpoint, conformance to specification results in less production costs and higher productivity due to a reduction in nonconforming items. In the marketing viewpoint, products with higher perceived values enhance customer satisfaction, resulting in an increased market share.

Both the improvements in productivity and increase in market share contribute to greater return on investment.

So far, the influence of TQM practices on performance results has not been investigated thoroughly and mixed findings are observed (Heyl 1987; US General Accounting Office 1991; American Quality Foundation and Ernest & Young 1992; Sluti 1992; Adam 1994; Maani et al. 1994). Moreover, the measurements of performance results were treated as dependent variables in those studies, leaving the relationships among Quality & Operational Results, Customer Focus & Satisfaction, and Financial Performance unexplored. Hypothesis 7 and 8 are intended to test the causalities among the three constructs relating to performance results in order to shed light on the validity of the causal relationships proposed by Deming (1982) and Garvin (1984a).

CHAPTER IV

RESEARCH METHODOLOGY

Research Design

Two methods of data collection, namely, survey and experiment, were considered. Since this paper aims at studying the causal relationships and outcome effectiveness of the TQM practices, it is almost impossible to carry out an experiment as it will be difficult to control the implementation of TQM practices in the business setting. A survey, therefore, was chosen as the instrument of collecting primary data for the research.

A cross sectional analysis was selected instead of longitudinal analysis because there was no specific survey for follow up study. Moreover, a complete longitudinal analysis will be too costly and time-consuming.

Questionnaire Design

Identification and Selection of Measurement Items in the Questionnaire

Based on extensive literature review on TQM articles, four organizational quality contextual variables, seven MBNQA criteria, and one Financial Performance construct were identified. Table 5 provides an exhaustive list of all the measurement items under each construct. The selection criteria of those constructs will be explained in the following paragraphs.

Saraph et al. (1989) identified eight critical factors of quality management which were applicable to both manufacturing and service industries. These factors were the Role of Top Management Leadership, the Role of Quality Department, Training, Product/Service Design, Supplier Quality Management, Management of Process Quality, Quality Data & Reporting, and Employee Relation. Despite the extensive coverage of these critical factors, it was found that the MBNQA provided an even more comprehensive TQM framework. All except the Role of Quality Department are addressed in the seven categories of the MBNQA. The Role of Quality Department, although not being explicitly addressed, is implicitly included in the Strategic Quality Planning category. The two most important categories of the MBNQA, that is, Customer Focus & Satisfaction and Quality & Operational Results were not captured in the eight critical factors. Table 6

shows how the eight critical factors are grouped into the seven MBNQA criteria.

The eight critical factors encompass 78 measurement items which can be used to prescribe four of the MBNQA criteria(Leadership, Information & Analysis, Human Resource Development & Management, and Management of Process Quality). Those 78 measurement items were preferred to the examination items in the MBNQA criteriabecause both sets capture essentially the same meaning but the former was tested against reliability and validity. Forty-six measurement items were selected out of the 78 measurement items, the rest being too specific or redundant (e.g. Item 22, 23, 27, 52, 53, 54, 65, 66, 67, see Saraph et al. 1989 for reference). Ten important measurement items selected from the examination items of the MBNQA were added into the questionnaire to complete the coverage of the MBNQA criteria. These items captured the issues of customer satisfaction, public responsibility, strategic quality planning process, and employee satisfaction.

The four organizational quality contextual variables were incorporated into the model. These included Managerial Knowledge, Corporate Support for Quality, Past Quality Performance, and Marketplace Environment. Benson

et al. (1991) provided 21 measurement items for the four constructs, 17 of which are used in the questionnaire.

Finally, the designs of measurement items of Quality & Operational Results and Financial Performance were adopted from several papers which related quality improvement practices to organizational performance (Adam 1994; Maani et al. 1994; Vickery et al. 1994). Costs of quality including internal failure costs, external failure costs, and preventive costs are included in Quality & Operational Results. Financial Performance measures company's return on sales, return on asset, and sales growth.

Measurement Method

All categories, except Quality & Operational Results and Financial Performance, were evaluated by the 7-point Likert scale to indicate the extent to which each item is being practised in respondents' business units. A typical question is shown below:

	Strongly Disagree	Disagree	Slightly Disagree	Neither Agree Nor Disagree	Slightly Agree	Agree	Strongly Agree
Top management assumes responsibility for quality performance	1	2	3	4	5	6	7

It is considered not appropriate to measure Quality & Operational Results and Financial Performance by the Likert scale. Actual percentage figure which is a consistent measure with the industry practice was used to evaluate such performance results so as to obtain a more accurate and objective response. Another advantage of using percentage figure is that it allows adjustments to be made across different industries. The adjustment methods will be discussed in later section.

Pretest and Refinement of the Questionnaire

The pretest was conducted by 60 diploma students from the quality management class in a university in Hong Kong. After the pretest, the priority and wording of the measurement items were rearranged to improve the coherence of the questionnaire. More importantly, it was suggested that two additional scales, "Don't Know" and "Not Relevant", should be included in the 7-point Likert scale to reduce biases. The reason is that some measurement items representing the TQM constructs may be either not known to the respondents or considered as irrelevant to the nature of their business units. The modified 7-point Likert scale for a typical measurement item in the final questionnaire is shown below:

	Strongly Disagree	Disagree	Slightly Diasgree	Neither Agree Nor Disagree	Slightly Agree	Agree	Strongly Agree	Don't Know	Not Relevant
Top management assumes responsibility for quality performance	1	2	3	4	5	6	7	8	9

The final questionnaire was composed of 84 measurement items representing the 12 constructs. The measurement items, together with 12 questions relating to company and quality demographics, comprised the whole questionnaire which was divided into three main parts: company/division demographics, quality improvement techniques, and company/division performance. A sample copy of the questionnaire is included in the appendix for reference.

Data Collection

It was designed that the questionnaires would be mailed to respondents. The primary problem of mailing, however, is the low response rate which would be particularly significant due to the comprehensiveness of the questionnaire. Therefore, several industrial associations were solicited for assistance in providing their member list or distributing the questionnaires in their regular mailings.

The Chinese General Chamber of Commerce (CGCC) has published a members' directory of about 3,500 companies. It was considered to be an appropriate sampling frame since different industry groups, categorized according to the Hong Kong Census and Statistics Department standard major industry group classification, are covered in both manufacturing and service industries. One thousand and two hundred companies were randomly selected from the members' directory and mailed out by CGCC in its regular mailings.

Vocational Training Council (VTC) has a member list of about 1,000 companies, 660 of which are the advisory committees from the largest and the most reputable firms in all major industry groups. A questionnaire was sent to each of the companies in the member list because it was believed that those companies could make the sample more representative in terms of company size and other company demographics.

An additional 380 copies of questionnaires were distributed to the ISO 9000 certified companies identified in the Buyer's Guide of Hong Kong Quality Assurance Agency (HKQAA). It was intended to include some of the ISO 9000 certified companies to explore any

underlying differences between certified and non-certified companies.

Finally, a convenient sample was taken from 116 students of two diploma courses in a university in Hong Kong. The students were supervisors or managers of companies from different industries, so they were qualified to provide responses concerning the implementation of TQM practices in their companies. Since the questionnaires measured organizational level practices rather than individual psychological attributes, the convenient sample was not expected to induce significant bias.

A total of 2796 questionnaires were mailed out and the completed questionnaires were directly mailed back to the researcher using the return envelop provided. The returned questionnaires were coded according to different sources of the sampling frame to facilitate the statistical test of sub-group differences.

Respondent Characteristics

Table 7 summarizes the response rate of different sources of the sampling frame. A total of 434 questionnaires were received, yielding an overall response rate of 15.5 percent. The satisfactory response

rate could be explained by the fact that the survey was endorsed by VTC and HKQAA. After data screening, 18 questionnaires were discarded due to excessive missing data. Another 15 questionnaires from government departments were also excluded because the study was only targeted for commercial industries.

Among the 401 valid questionnaires, 124 companies are manufacturing industry, 226 companies are service industry and 51 companies are both manufacturing and service industries. Companies which are engaged in both manufacturing and service, according to the definition given in ISO 9004 Part 2, are also considered as manufacturing companies (International Organization for Standardization 1994). A detailed respondent profile by major industry groups is shown in Table 8. The company demographics and quality demographics are summarized in Table 9 and Table 10 respectively.

Results of MANOVA in Table 11 show that there are no statistically significant sub-group differences in terms of sample source, nature of industry, company size, presence of quality department and ISO 9000 certification ($F_{84,256} = 0.789$, $p = 0.887$). Thus, the basic assumptions of homogeneity sample were held. It was believed that a rather representative sample was selected so that the

results could be generalized to the population for the study.

A cross tabulation of ISO 9000 certification with nature of industry shows that there exists high association between the two factors. As shown in Table 12, manufacturing industry accounts for 66.2 percent of ISO 9000 certified companies. On the other hand, 76.5 percent of companies in service industry do not acquire the certification. Another similar cross tabulation of ISO 9000 certification with the presence of quality department is shown in Table 13. It can be seen that 74.5 percent of ISO certified companies have established separate quality departments, whereas 81.7 percent of companies without separate quality departments are not ISO 9000 certified. One reasonable explanation is that ISO 9000 certified companies require separate quality departments to document and implement their quality systems. Moreover, careful examination of ISO 9000 certification across the major industry groups revealed that the certification is industry specific. Table 14 shows that more than 70 percent of the companies in the electrical & electronic products and construction industry are ISO 9000 certified. In trading industry and finance industry, only 16.1 percent and 6.2 percent of

the companies have acquired ISO 9000 certification respectively. It is concluded that ISO 9000 certification is more important for industries subject to government compliance or product liabilities.

Table 15 provides figures of the quality and financial performance measures. It is worth pointing out that the total costs of quality are as high as 28.66 percent which account for an average of 367 million dollars per company per year! Hence, identifying the rooms for quality improvement could contribute to tremendous cost savings in the real business.

Adjustment of Industry Effect

An examination of the publication from the Hong Kong Census and Statistics Department revealed that financial performance of different major industry groups varied substantially. For example, the return on sales/return on asset recorded a maximum of 65.80 percent for the finance industry but a minimum of 5.25 percent for the construction industry, showing a difference of ten-fold! A similar case was observed in sales growth in which the figure ranged from -30.32 percent in the rubber & plastic industry to 25.33 percent in the community industry. Such an immense difference in financial performance could

be explained by many factors such as market competition, industry structure, product nature and maturity, and customers' willingness to pay.

The significant difference across industry groups would very likely mask any variations in financial performance due to TQM implementation. This explains why past empirical study showed inconsistent relationships between TQM practices and financial performance, especially in cross-sectional analysis. Accordingly, performing an industry adjustment could be an appropriate way to prevent such noises from disturbing the statistical results. Anderson et al. (1995) detected the presence of industry effect and systematically controlled such effect, resulting in a satisfactory path analysis results.

In this study, the industry effect on financial performance was mitigated by introducing an adjustment term to eliminate the systematic variation across different industry groups from each measurement item. Mathematically, this can be shown as follows:

$$Y_{i,j,Adj.} = Y_{i,j,Obs.} - (\mu_{i,j} - \mu_i)$$

where: i = the 6 measurement items in Financial. Performance, i.e. Y58 - Y63

j = the 22 major industry groups

$Y_{i,j,Adj.}$ = the industry adjusted variable for the i measurement item of the j industry

$Y_{i,j,Obs.}$ = the observed variable for the i measurement item of the j industry

$\mu_{i,j}$ = the population mean of the i measurement item of the j industry

μ_i = the population mean of the i measurement item of the whole industry

$\mu_{i,j} - \mu_i$ = the adjustment term of the i measurement item of the j industry

Table 16 summarizes the population means and adjustment terms of the measurement items for the 22 major industry groups. Conceptually, the industry adjustment in fact "compensates" or "penalizes" each industry by adding the "deficit" or subtracting the "surplus" to the observed variables respectively, using the population mean of the whole industry as the reference frame. Thus, objective measures of financial performance relative to those of the same industry could be indirectly estimated. Accordingly, any variation in financial performance in the observed variables should mainly be accounted for by other factors such as TQM practices rather than the industry effect.

An industry adjustment for the quality results should be computed as well, given the diversity of process capability resulted from different product complexity and technological advancement across different industries. Such adjustment, however, is impossible at this stage because the population means of costs of quality are not available. None of the organizations including the Hong Kong Census and Statistics Department, Hong Kong Productivity Council, Hong Kong Quality Assurance Agency and Hong Kong Society for Quality Control, have records of quality data for the whole industry, not to mention every major industry group. Computing industry adjustment of quality results using sample means would not be reliable measures because of the small sample sizes for several major industry groups ($n < 30$).

CHAPTER V

STATISTICAL ANALYSIS

Analysis of Construct Reliability

Construct reliability is the internal consistence of a set of measurement items indicating the constructs. Highly reliable constructs are those in which the measurement items are highly intercorrelated and homogeneous (Hair et al. 1992). Cronbach's alpha (α) is the most popular reliability coefficient used to measure internal consistency (Nunnally & Bernstein, 1994). A construct consisting of any subset of the items that has the highest reliability coefficient is likely to be the best with regard to internal consistency (Saraph et al. 1989). Nunnally & Bernstein (1994) suggested the minimum criterion of α should be 0.6 in order to ensure internal consistency.

An exploratory assessment of reliability was conducted to examine the internal consistency of each construct. Screen plots of item-total statistics were used to provide an evaluation of the marginal contribution of every item to the construct reliability.

Outliers with low item-total statistics were successively eliminated until the reliability coefficient was maximized, striking a balance between the number of measurement items and their average correlation (Sellitz et al. 1976). Table 17 lists the reliability coefficient of each construct after deletion of measurement items with low item-total statistics. The results show that the reliability coefficients of all constructs except Marketplace Environment are above 0.7, thus the constructs are deemed to be adequately reliable (Nunnally & Bernstein, 1994). The construct of Marketplace Environment was excluded for further analyses due to very low reliability scale (α = 0.358) resulted from the large variation in the measurement items concerning the degree of competition across different industries.

Analysis of Validity

The validity of a construct refers to the extent to which it measures what is intended to be measured. It reflects the ability of the measurement items of a construct to measure the concept under the study accurately (Hair et al. 1992). Both content validity and construct validity had been examined before further analyses were conducted. Other analyses of validity

including convergent validity, discriminant validity, and predicting validity were assessed after development of the structural equation modeling.

Content Validity

A construct has content validity if there is a general agreement that all aspects of the variable being measured are covered by the measurement items of the construct (Nunnally & Bernstein, 1994). The requirements of content validity were fulfilled in this study because the measurement items of each construct were selected from an extensive review of literature. The content domain of the TQM constructs includes the measurement items from the quality management instruments developed by Saraph et al. (1989) and the examination criteria set by MBNQA, both of which are generally considered as well established TQM measurement items. For the organizational quality contextual variables, Benson et al. (1991) provided a comprehensive coverage of the measurement items for each variable. The construct of Quality & Operational Results captured the crucial measurement items like percentage of items defective, internal failure costs, external failure costs, and preventive costs (Adam 1994; Maani et al. 1994).

Traditional financial performance including return on sales, return on asset, and sales growth were included as in many of the previous studies (Adam 1994; Vickery et al. 1994). Finally, the pretest comments provided a further reassurance of content validity.

Construct Validity

Construct validity measures the extent to which the items in a scale all measure the same construct (Ghiselli et al. 1981). The construct validity of each construct was assessed by examining the factor loadings as well as the eigenvalues generated by within-scale factor analysis. Table 17 shows that all constructs exceed the minimum eigenvalue criterion of 1 and all measurement items have high unifactorial loadings. Thus, it is concluded that the measures of the constructs have construct validity and that all constructs are unifactorial.

Analysis of Structural Equation Model

Since the constructs passed the requirements of reliability and validity, further statistical analysis, or structural equation modeling can be performed to provide insight on the causal relationships among the constructs.

LISREL (Joreskog & Sorbom 1993) is the most popular and commonly accepted statistical package for structural equation modeling and has been widely used in many disciplines including sociology, psychology, management, and operations management. LISREL provides estimations on both the ability of the measurement items (observed variables) to represent a construct and the multiple and interrelated dependence relationships among the constructs (latent variables) in a single-step analysis. Accordingly, analyses of measurement model and structural model can be simultaneously computed to provide a precise set of parameter estimates (Joreskog & Sorbom 1993).

It should be emphasized, however, that analysis of structural equation modeling should be theory-driven. All paths in the measurement model and structural model have to be specified a priori, followed by statistical analysis to determine if the sample data are consistent with the imposed constraints in the model. Any causal relationships drawn are on the basis of theory which gains support by failing to be disconfirmed (Anderson & Gerbing 1988). Structural equation modeling is intended to combine empirical quantitative information given by correlations with such theoretical qualitative

information to give a quantitative interpretation (Wright 1934).

Prior to structural equation model analysis, the results of residual plots and Cook's distances were examined to make sure that the variables conform to the assumptions of constant variance and absence of influential outliers (Hair et al. 1992). Then all variables were transformed to standard normal distributions to satisfy the requirements of the analysis (Flynn et al. 1995). All constructs, except Financial Performance, were negated so that the scale credits superior practices and debits inferior practices (Vickery et al. 1994). All the parameter estimates are expected to be positive in confirmation with the theory.

Analysis of Overall Model Fitness

The LISREL output provides an evaluation of overall model fitness. As shown in Table 18, all fit indexes except Parsimony Goodness of Fit Index (PGFI) exceed 0.90, the benchmark of good overall fitness as suggested by Bentler & Bonett (1980). The important fit indexes like Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Non-Normed Fit Index (NNFI), and Comparative Fit Index (CFI) are all nearly 0.98. On the

other hand, the Root Mean Square Residual (RMSR) is only 0.064. This indicates that the model is able to explain most of the variation in the sample. Finally, it is worth noticing that the Chi-Square (χ^2) of the result should be interpreted very cautiously in evaluating the overall model fitness for this data set. Since Chi-Square is sample size sensitive, the measure becomes less reliable as sample size falls beyond the range of 100-200. Specifically, Chi-Square would tend to detect any insignificant differences for practically equivalent models as sample size exceeds 200 (Hair et al. 1992). Thus, the high χ^2/df of 1.80 is caused by the large sample size (n = 401) rather than overall model unfitness. As a whole, the specifications of the structural equation model are confirmed as indicated by the adequacy of overall model fitness.

Analysis of Measurement Model

A confirmatory factor analysis (CFA) was conducted to confirm if the sample data are consistent to the proposed constructs. Table 19 summarizes the standardized factor loadings (λ) and the squared multiple correlations (R^2), which measure the extent of indication of the corresponding construct and the proportion of variance extracted by the measurement items respectively. The

results show that the R^2 values of all but five of the 51 measurement items are in the range of 0.5 to 0.9 (lowest R^2 = 0.471), meaning that the variance captured by the measurement items exceeds the variance due to measurement errors. The high standardized factor loadings ($0.691 < \lambda < 0.948$, all $p < 0.005$) demonstrate convergent validity as different measurement items indicate the corresponding construct adequately. The correlation matrix of factor loadings shows that each measurement item has strong correlation with others within the same construct but very weak correlation with other constructs. Hence, discriminant validity is achieved as the factor loadings of each construct are differentiated.

Analysis of Structural Model

Structural modeling is a multivariate analytical methodology for examining a network of dependence relationships in a linear casual model. In this section, the causal relationships specified among the constructs are examined to provide empirical support for the hypotheses proposed from the theory.

The results of analysis including the R^2, error variance and the standardized path coefficients of the structural equations are presented in Table 20. The R^2 measures the proportion of variation in a dependent

variable explained by the independent variables in the structural equation. The standardized path coefficient expresses the magnitude or strength of causal relationship between two constructs.

Using the first row of Table 20 as an example, it shows that 3 constructs, namely, Managerial Knowledge, Corporate Support for Quality, and Past Quality Performance are statistically significant determinants of Leadership ($p < 0.005$). Corporate Support for Quality is the top contributor to Leadership as indicated by the highest value of standardized path coefficient ($P_{\eta 1 \xi 2} = 0.849$). On the other hand, Managerial Knowledge and Past Quality Performance show much weaker relationships to Leadership. The three constructs together explain 88.1 percent of the variation in leadership. A diagrammatic presentation of the path coefficients and the corresponding significance level is also shown in Figure 4. Similar explanations can be drawn from the rest of the table and the diagram.

Path Analysis

From the estimation of path coefficients, it is possible to further decompose the observed correlation between any two variables into three components, namely,

direct effect, indirect effect, and unexplained effect. Direct effect is simply the path coefficient of the independent variable in the structural equation. Indirect effect can be computed by multiplying the coefficients of composite paths joining the two variables together. Whereas there is only one possible path for the direct effect between two variables, indirect effect could be made up from many composites of paths. Referring to Figure 4, for example, the sum of indirect effects of Leadership on Management of Process Quality is computed as $P_{\eta 2 \eta 1} * P_{\eta 3 \eta 2} * P_{\eta 4 \eta 3} * P_{\eta 5 \eta 4} + P_{\eta 2 \eta 1} * P_{\eta 3 \eta 2} * P_{\eta 5 \eta 3} + P_{\eta 3 \eta 1} * P_{\eta 4 \eta 3} * P_{\eta 5 \eta 4} + P_{\eta 3 \eta 1} * P_{\eta 5 \eta 3} + P_{\eta 4 \eta 1} * P_{\eta 5 \eta 4} = 0.884 * 0.697 * 0.371 * 0.178 + 0.884 * 0.697 * 0.265 + 0.296 * 0.371 * 0.178 + 0.296 * 0.265 + 0.557 * 0.178 = 0.401$, meaning that the sum of indirect effects is accounted for by five different series of paths. Accordingly, the sum of indirect effects of Corporate Support for Quality on Financial Performance is composed of many complex series of paths via all the seven mediating variables.

The sum of direct effect and indirect effect is called the total meaningful effect of one variable on another (Asher 1983). An unexplained effect is the residue of the observed correlation between two variables not explained by the total effect. Thus, the unexplained

effect can serve as indicator of how well the path diagram is supported empirically and the proposed theory is described conceptually (Anderson et al. 1995). Table 21 shows the correlation matrix among all the exogenous and endogenous variables. The decomposition of observed correlation into their respective direct, indirect, and unexplained effects are listed in Table 22. The interpretation of Table 22 is illustrated by the following example. The direct effect and indirect effect of leadership on Strategic Quality Planning are 0.296 and 0.616 respectively, adding to the a total effect of 0.912. Since the standardized path coefficients are identical to the standardized regression coefficients (Li 1975), this means that a unit change in leadership would result in 0.912 unit change in Strategic Quality Planning via all direct and indirect effects. The unexplained effect of leadership on Strategic Quality Planning is 0.001, amounting to approximately 0.1 percent of the observed correlation between the two constructs.

Hypothesis Testing

The results of path analysis as shown in Table 22 provide support, or lack of empirical evidence for each

of the eight proposed hypotheses to be confirmed in the following paragraphs.

Hypothesis 1: Organizational quality context, including Managerial Knowledge, Corporate Support for Quality, Past Quality Performance, and Marketplace Environment, has a direct and positive influence on Leadership.

The hypothesis is supported as indicated by the path coefficients from Managerial Knowledge ($P_{\eta 1 \xi 1} = 0.048$, $p < 0.01$), Corporate Support for Quality to Leadership ($P_{\eta 1 \xi 2} = 0.849$, $p < 0.005$), and Past Quality Performance ($P_{\eta 1 \xi 3} = 0.106$, $p < 0.005$). This means that leadership could be enhanced by all the three organizational quality contextual variables. It can be seen that Corporate Support for Quality has much stronger influence on Leadership than the other two organizational quality contextual variables. A detail observation reveals that Corporate Support for Quality also exerts statistically and practically significant indirect effects on all other constructs subsequent to Leadership.

Hypothesis 2a: Leadership has a direct and positive influence on Information & Analysis, Strategic Quality

Planning, Human Resource Development & Management, and Management of Process Quality.

The results of structural model show that there exist strong and significant causal effects of Leadership on the 4 constructs in operational system: Information & Analysis ($P_{\eta 2 \eta 1}$ = 0.884, $p < 0.005$), Strategic Quality Planning ($P_{\eta 3 \eta 1}$ = 0.296, $p < 0.05$), Human Resources Development ($P_{\eta 4 \eta 1}$ = 0.557, $p < 0.005$), and Management of Process Quality ($P_{\eta 5 \eta 1}$ = 0.494, $p < 0.005$). Top management, therefore, is responsible for the improvement of every element in the operational system. The impact of Leadership on Information & Analysis is more influential than the remaining three constructs.

Hypothesis 2b: Leadership has an indirect and positive influence on Quality & Operational Results and Customer Focus & Satisfaction mediated by the operational system.

The indirect effects of Leadership on Quality & Operational Results ($I_{\eta 6 \eta 1}$ = 0.725, $p < 0.005$) and Customer Focus & Satisfaction are justified ($I_{\eta 7 \eta 1}$ = 0.707, $p < 0.005$). It can be concluded that top management also plays an important role in steering the organization

towards performance excellence and customer satisfaction by encouraging competitiveness in operational system.

Hypothesis 3a: Information & Analysis has a direct and positive influence on Strategic Quality Planning.

The relationship between Information & Analysis and Strategic Quality Planning is supported by empirical evidence ($P_{\eta 3 \eta 2} = 0.697$, $p < 0.005$). So, the availability of fast, accurate, and reliable information will improve the effectiveness of strategic planning activities by employing various decision analysis techniques.

Hypothesis 3b: Information & Analysis has an indirect and positive influence on Human Resource Development & Management, Management of Process Quality, Quality & Operational Results, and Customer Focus & Satisfaction.

The results provide empirical evidence for the existence of moderate indirect effects of Information & Analysis on Human Resources Development & Management ($I_{\eta 4 \eta 2} = 0.258$, $p < 0.005$), Management of Process Quality ($I_{\eta 5 \eta 2} = 0.231$, $p < 0.05$), Quality & Operational Results ($I_{\eta 6 \eta 2} = 0.197$, $p < 0.01$), and Customer Focus & Satisfaction ($I_{\eta 7 \eta 2} = 0.192$, $p < 0.005$). Overall, Information & Analysis can

be used as a strategic tool to improve operational system and enhance quality performance and customer satisfaction.

Hypothesis 4a: Strategic Quality Planning has a direct and positive influence on Human Resources Development & Management and Management of Process Quality.

The path coefficients leading to Human Resources Development & Management ($P_{\eta 4 \eta 3}$ = 0.371, $p < 0.005$) and Management of Process Quality ($P_{\eta 5 \eta 3}$ = 0.265, $p < 0.005$) from Strategic Quality Planning are moderately strong. Thus, if quality plans such as strategic deployments are addressed clearly, resources will be organized more effectively and efficiently for employee development and process improvement.

Hypothesis 4b: Strategic Quality Planning has an indirect and positive influence on Quality & Operational Results and Customer Focus & Satisfaction.

The hypothesis is supported as shown by the existence of indirect effect of Strategic Quality Planning on Quality & Operational Results ($I_{\eta 6 \eta 3}$ = 0.283, $p < 0.01$) and Customer Focus & Satisfaction ($I_{\eta 7 \eta 3}$ = 0.276, $p < 0.005$). Accordingly, competitive results and customer

satisfaction can be achieved by building key quality requirements into strategic formulation process.

Hypothesis 5a: Human Resource Development & Management has a direct and positive influence on Management of Process Quality and Quality & Operational Results.

The results show that Human Resource Development & Management has a positive influence on both Management of Process Quality($P_{\eta 5 \eta 4}$ = 0.178, $p < 0.005$) and Quality & Operational Results ($P_{\eta 6 \eta 4}$ = 0.377, $p < 0.005$). This means that participation of well trained employees can enhance the operation of process management. An efficient workforce can also directly contribute to better quality and operational results by fully committing themselves in achieving performance excellence.

Hypothesis 5b: Human Resource Development & Management has an indirect and positive influence on Customer Focus & Satisfaction.

It can be shown that Human Resource Development can indirectly influence Customer Focus & Satisfaction mediated by Quality and Operational Results ($I_{\eta 7 \eta 4}$ = 0.442, $p < 0.005$). Human resource empowered with TQM techniques

can produce high quality products which in turn satisfy customer requirements. This confirms with the theoretical relationship as suggested by most of the quality gurus.

Hypothesis 6a: Management of Process Quality has a direct and positive influence on Quality & Operational Results.

The hypothesis is empirically justified from the significant path coefficient from Management of Process Quality to Quality & Operational Results ($P_{\eta 6 \eta 5} = 0.433$, $p < 0.005$). An improvement in process management will result in producing products of higher quality. Statistical process control, for example, is an effective tool in reducing process variation so that the products are conformed to the design specifications. On the other hand, higher productivity would be achieved by employing a preventive approach in process management which aims at reducing the costs of quality to a minimum.

Hypothesis 6b: Management of Process Quality has an indirect and positive influence on Customer Focus & Satisfaction.

The analysis shows a moderate relationship between Management of Process Quality and Customer Focus &

Satisfaction ($I_{\eta 7 \eta 5}$ = 0.422, p < 0.005). By incorporating customer opinions and views into product design and development, products with higher perceived value can be produced to satisfy customer requirements.

Hypothesis 7: Quality & Operational Result has a direct and positive influence on Customer Focus & Satisfaction and Financial Performance.

The hypothesis is only partially supported by empirical evidence. Interestingly, the effect of Quality & Operational Results is found to be very strong on Customer Focus & Satisfaction ($P_{\eta 7 \eta 6}$ = 0.975, p < 0.005), but statistically insignificant on Financial Performance ($P_{\eta 8 \eta 6}$ = 0.752, p > 0.1). As explained before, customer satisfaction could be enhanced by delivering products of high quality characteristics, such as those defined by Garvin's (1987) eight principal quality dimensions. However, the insignificant relationship between Quality & Operational Results and Financial Performance is unexpected, given the existing theoretical foundation. The Deming chain reaction (Deming 1982), for example, provides an explanation for the causal relationship between Quality & Operational Results and Financial Performance. Accordingly, improvement in quality leads

to lower costs and higher productivity, followed by greater market share and return on investment. The unexpected result implies that some underlying problems might exist in the specification of the model. The issue will be explained in the next Chapter.

Hypothesis 8: Customer Focus & Satisfaction has a direct and positive influence on Financial Performance.

The insignificant path coefficient from Customer Focus & Satisfaction to Financial Performance ($P_{\eta 8 \eta 7}$ = -0.610, $p > 0.1$) shows that the hypothesis is not supported in this study. The empirical finding, therefore, is not consistent with the theoretical justification that higher customer satisfaction will contribute to more competitive financial performance. This unexpected finding, together with the insignificant result in hypothesis 7, suggests that a refinement of the model is necessary to provide an interpretation for the discrepancy between theoretical explanation and empirical finding.

CHAPTER VI

REFORMULATION OF THE MODEL

A holistic TQM model was built to confirm the causal relationships among the organizational quality context, the MBNQA criteria, and Financial Performance. Overall, the data fits the model adequately as evident from the fit statistics. Of the eight proposed hypotheses, six are highly supported by empirical evidence. The two hypotheses relating to Financial Performance, however, are not statistically significant even at the 0.1 significant level. The failure to uncover the casual relationships among Quality & Operational Results, Customer Focus & Satisfaction, and Financial Performance may provide insight on the validity of the theory and the specification of the model.

Given the establishment of solid theoretical basis on the effectiveness of quality results on financial performance (Deming 1982; Garvin 1984a), it is unlikely that the empirical evidence in this study can disconfirm the validity of the theory. Alternatively, such

difference may be explained by statistical problem in the analysis of structural model.

Referring to the correlation matrix in Table 21, it can be seen that Quality & Operational Results and Customer Focus & Satisfaction, the two independent variables of Financial Performance, are highly correlated ($\gamma_{\eta 6 \eta 7} = 0.975$). The high correlation coefficient between these two variables suggests the presence of multicollinearity in the corresponding regression equation (Asher 1983). A stronger evidence is shown by the high R^2 in the equation regressing Customer Focus & Satisfaction against Quality & Operational Results ($R^2 = 0.950$), meaning that the two variables are in fact highly dependent on each other (Lewis-Beck 1980).

The problem of multicollinearity can be solved by eliminating one of the highly correlated independent variables or combining them together into a scale (Asher 1983). Both approaches will be demonstrated in the following paragraphs.

To remove the problem of multicollinearity, one of the two variables, Quality & Operational Results and Customer Focus & Satisfaction, should be eliminated from the regression equation of Financial Performance. Since customer satisfaction is the result of quality

performance, it is more appropriate to regress Financial Performance against Customer Focus & Satisfaction. Figure 5 shows the revised model in which the direct path from Quality & Operational Results to Financial Performance is eliminated. The results indicate a significant and positive relationship between Customer Focus & Satisfaction and Financial Performance ($P_{\eta 8 \eta 7}$ = 0.154, $p < 0.005$). The overall model fitness (χ^2/df = 1.80) as well as the path coefficients of all other constructs are statistically and practically unchanged.

In the second approach, the two constructs of Quality & Operational Results and Customer Focus & Satisfaction are combined into a single construct. This new construct may be named as Quality & Customer Satisfaction Performance which becomes the independent variable of Financial Performance as shown in Figure 6. While the overall model fitness (χ^2/df = 1.80) and all other parameter estimates are insensitive to such change, Financial Performance is positively and significantly related to Quality & Customer Satisfaction Performance ($P_{\eta 8 \eta (6+7)}$ = 0.154, $p < 0.005$).

Interestingly, both approaches give the same estimation of path coefficient (0.154) and R^2 (0.240). The consistent results demonstrate that reliable measures

of the strength and explanatory power of the independent variables to Financial Performance are estimated. Among the two alternatives, the former approach is preferred for the following reasons. Firstly, the former approach only slightly modifies the structural relationship between two constructs. On the other hand, the latter approach combines two constructs into a new scale, the composite variables of which may be more difficult to interpret than the original variables. Secondly, combining collinear variables together violates the true specification linking the independent and dependent variables (Asher 1983). In other words, the effect of Quality & Operational Results and Customer Focus & Satisfaction on Financial Performance cannot be studied separately if the two constructs become one single measure. Finally, although the independent variable of Quality & Operational Results is eliminated in the regression equation in the former approach, path analysis provides an indirect effect of Quality & Operational Results on Financial Performance mediated by Customer Focus & Satisfaction ($I_{\eta 8 \eta 6} = 0.151$, $p < 0.05$). Given that the reformulation of the model aims at solving the problem of multicollinearity rather than providing an

alternative interpretation of the underlying theory, the first alternative model is more appropriate.

Under the reformulated model, hypothesis 7 is supported if the influence of Quality & Operational Results on Financial Performance is regarded as indirect effect rather than direct effect, whereas hypothesis 8 is straight supported. The results of the reformulated measurement model are identical to the previous one as shown in the original Table 19. The estimation of reformulated overall model fitness is shown in Table 23. The results of the reformulated structural model are depicted in Table 24. The revised figures for correlation matrix and path analysis are summarized in Table 25 and Table 26 respectively. These tables, in addition to Figure 5, present all the results of the reformulated structural model on which the discussion section will base.

CHAPTER VII

DISCUSSION

The results of structural equation modeling provide strong empirical evidence for the proposed holistic TQM model. The measurement items associated with all constructs except Marketplace Environment were identified as reliable and valid indicators of the domains issues underlying the model. The structural model provides empirical evidence for the confirmation of the theoretical causal relationships proposed in the eight hypotheses. In this section, explanations will be given to the important findings in each of the analysis . More importantly, the implications for possible theoretical development and managerial practices will be discussed.

The Measurement Model

It has been mentioned that most of the past research on TQM framework are conceptual, with little attempt in operationalizing the concepts. Consequently, these conceptual constructs are not directly measurable, making implementation of TQM practices and evaluation of the

progress more difficult. Some case studies addressed in detail the operational items of the conceptual constructs (Ham & Williams 1986; Newall & Dale 1991), but the orientation of case study lacks empirical testing and generalization. This study extends previous academic work by developing a comprehensive list of measurement items from an integrative TQM framework. The data were collected from the managers of different representative industries. The high reliability scales and factor loadings in the measurement items demonstrate that the instruments developed are reliable and valid measures of the underlying TQM concepts. The important measurement items of each construct, which are summarized in Table 19, are reviewed as follows.

Three constructs, namely, Managerial Knowledge, Corporate Support for Quality, and Past Quality Performance are the significant constructs of the organizational quality context. It is found that the top indicators of the organizational quality context are consistent to Deming's Philosophy of developing a learning organization for TQM. For example, Deming (1993) mentioned that leaders themselves must be "unceasing learners" and should attend "seminars and courses for advancement of learning". The item that

measures this issue (X2), has the highest factor loading and R^2 in Managerial Knowledge (λ = 0.940, R^2 = 0.883). Within the context of Corporate Support for Quality, the measurement items that capture the fostering of an organization's commitment to quality (X9) and provision of infrastructure for quality improvement purpose (X11, X12) are highly scored (λ = 0.840 - 0.896, R^2 = 0.706 - 0.802). Finally, Past Quality Performance can provide feedback on the effectiveness of quality management (Benson et al. 1991) and the two associated measurement items (X13, X14) are the good indicators of the construct (λ = 0.918 - 0.948, R^2 = 0.844 - 0.900).

The constructs of the seven MBNQA criteriaare all supported in the measurement model. Top management's responsibility in creating clear and visible quality values and objectives (Y4, Y5) and participation in quality improvement process (Y3, Y6, Y7) are the more important items in Leadership (λ = 0.839 - 0.877, R^2 = 0.704 - 0.770). In Strategic Quality Planning, the two examination items taken from the MBNQA criteria (Y13, Y14) serve well to measure the construct (λ = 0.822 - 0.889, R^2 = 0.675 - 0.790). The measurement items relating to analysis and use of quality data (Y9, Y12) in

Information & Analysis and employee training (Y19, Y20, Y22, Y23) and participation (Y15, Y18, Y21) in Human Resource Development & Management carry high factor loadings and R^2 in the measurement model (λ = 0.742 - 0.846, R^2 = 0.551 - 0.715). This is consistent with the relatively high scoring weights of these items in the respective MBNQA criteria (53%). In the construct of Management of Process Quality, statements prescribing design, conformance, and coordination between production and marketing departments (Y28 - Y32) are all statistically significant measurement items. This finding converges with Roth & Giffi's (1994) definition of quality in both the production viewpoint (conformance to specification) and marketing viewpoint (value perceived). Other fundamental process control issues, for examples, statistical process control (Y34), preventive measures (Y35, Y38), and continuous improvement (Y40) are also identified in the measurement model. Items concerning supplier management under Management of Process Quality (Y44 - Y48), however, are found to be unreliable measurements in this study. This may imply inconsistent approaches to supplier management practices adopted by Hong Kong companies. Since these items were found to be significant measures in Benson et

al.'s study (1991), further research is worth undertaking to explore the status of implementation of supplier management in Hong Kong industries.

Despite the lack of formal records for quality data, measurements regarding internal and external costs of quality (Y49 - Y52) are considered as reliable and important indicators of Quality & Operational Results. The item concerning training and development expenditure (Y53) was excluded due to low item reliability. This could be explained by the fact that training and development, a preventive expenditure, is differentiated from other incurred costs of quality. The satisfactory statistics of the measurement items in the construct (λ = 0.736 - 0.790, R^2 = 0.541 - 0.624) indicate that the data serve well as a primary estimator of costs of quality. Since no industrial associations have conducted surveys to measure costs of quality, the quality data collected in this study have significant contribution to both the business and academic fields. The figures could be used as benchmarks for managers to evaluate the competitiveness in achieving quality performance in their companies. The descriptive statistics of costs of quality, as shown in Table 15, could also be used as

"prior parameters" in Bayesian approach for more precise estimation in future research.

The reliability measure of Customer Focus & Satisfaction (α = 0.771) is found to be the lowest among all other constructs (not counting Marketplace Environment which had been excluded from the model), though the scale exceeds the minimum criteria of 0.6. Also, three out of the four associated measurement items have R^2 lower than 0.5 (lowest 0.471). These indicate that the measurements of Customer Focus & Satisfaction are only marginally acceptable, with the underlying domain of customer satisfaction not adequately explored. One way to explain the low reliability scale and R^2 is the use of perceptual method to operationalize the conceptual construct. This means that customer satisfaction is measured based on managers' perception rather than customers' feedback. Given the scope of this study, it would be very difficult, if not impossible, to obtain an accurate, reliable, and external based measurement for empirical analysis. Direct assessment of customer satisfaction in the eyes of customers would be invaluable to provide much more objective responses.

Finally, the construct of Financial Performance consists of traditional measurement items including

return on sales (Y58, Y59) and return on asset (Y60, Y61). Measurement items concerning sales growth (Y62, Y63) were deleted due to drastic changes in sales figures in the past three years in the sample data, resulting in low item reliability. While the data of Financial Performance provide objective measurements as opposed to that of Customer Focus & Satisfaction, variations in product and market natures across different industries could result in distorted descriptions on the true profitability. As mentioned in the methodology section, such industry effect was systematically minimized by computing an adjustment term for every industry. Essentially, the industry adjustment improves the value of α of Financial Performance from 0.703 to 0.908, or 29.2 percent increase in the reliability scale. As a result, it is possible to evaluate the effectiveness of TQM practices with the highly reliable measures of Financial Performance.

The Structural Model

This section provides a detailed discussion of the findings of the structural model. Specifically, a quantitative justification of the causal relationships among the constructs will be discussed to identify the

extent to which each construct contributes to outcome effectiveness. This elaborates previous research studies and consolidates theoretical development by providing an empirical validation of TQM theory. The quantitative and empirical based evaluation has practical implications to managers in identifying the determinant factors among a wide array of TQM practices for strategic improvement in performance objectives

The eight hypotheses addressing the causal relationships proposed in the TQM literature are all empirically supported in the reformulated model. The strength of causalities among the constructs, including direct effects and indirect effects, could be quantified by comparing the standardized path coefficients in Table 26. The unexplained effects and R^2, on the other hand, may serve as indicators to assess identification and specification of the model respectively.

Leadership is found to be the most influential factor on the effectiveness of TQM implementation. Leadership, which acts as the driver of the operational system in the MBNQA model, appears to have direct effects on Information & Analysis, Strategic Quality Planning, Human Resource Development & Management, and Management of Process Quality. In addition, all possible indirect

effects leading from Leadership to the other six MBNQA constructs are found to be highly significant. This means that the effect of Leadership can actually perforate every factor in striving for the organizational goal. The indirect impacts of Leadership on Quality & Operational Results and Customer Focus & Satisfaction are especially strong ($I_{\eta 6 \eta 1} = 0.727$, $p < 0.005$; $I_{\eta 7 \eta 1} = 0.714$, $p < 0.005$). These confirm the theoretical justification that top management is responsible for quality performance and customer satisfaction. The decomposition of observed correlation shows that the sum of direct effect and indirect effect is an exact reproduction of the respective observed correlation (except in Strategic Quality Planning in which a trivial 0.1% of unexplained effect is observed). Alternatively, this means that the empirical relationship is fully accounted for by the total meaningful effect, leaving a zero residue in the unexplained effect (Li 1975). Since Leadership is highly correlated with all the other six MBNQA criteria, the total effects are accordingly very strong.

If Leadership is so integral to the effectiveness of the organizational practices and performance, what are the factors that can encourage a more progressive top management? Analysis of structural model reveals that

all the three organizational quality contextual variables are determinants of Leadership and together explain 88.1 percent of the observed variance in Leadership. In term of practical significance, however, Corporate Support for Quality is the top indicator of Leadership as evident from the highest path coefficient ($P_{\eta 1 \xi 2}$ = 0.850, $p < 0.005$). Thus, if an organization provides a quality-orientated environment with adequate resources to support quality improvement, top management will be encouraged to perform better in directing the operational system and pursuing goal congruence. The finding is similar to that of Longenecker & Scazzero (1993) in which TQM implementation was found to be unsatisfactory in organizations failing to create a climate for quality practices.

The direct and indirect effects among the rest of the six MBNQA criteriaare all statistically significant as mentioned in hypothesis testing. A large amount of unexplained effects (averaged 56.7 %), however, are observed in these constructs, with the exception in the relationship between Quality & Operational Results and Customer Focus & Satisfaction. There are three possible explanations for the unexplained effect, namely, spurious effects caused by antecedent factors, spurious effects

caused by factors not included in the model and overidentification of the model among the constructs. The high R^2 values ($0.610 < R^2 < 0.939$) in the corresponding structural equations imply that the independent variables are well specified. Hence, the possibility of overlooking disturbance covariance induced by missing variables is low. On the other hand, the presence of spurious effects emerging from Leadership and incomplete specification of causal relationships are empirically evidenced. The following examples provide numerical illustration to explain these concepts.

First, it is found that the direct effect cannot fully account for the observed correlation between Information & Analysis and Strategic Quality Planning. The unexplained effect of 0.262 (27.3%) in fact can be completely explained by the spurious effect of Leadership, which is the common cause of both constructs. The spurious effect of 0.262 ($S_{\eta 3 \eta 2} = P_{\eta 2 \eta 1} * P_{\eta 3 \eta 1} = 0.884 * 0.296$), when added to the unchanged direct effect, would give a total effect of 0.959 ($T_{\eta 3 \eta 2} = 0.697 + 0.262$) which is numerically equivalent to the observed correlation. This spurious effect is not considered as a problem in the identification and specification of the model but is practically meaningless in term of causality.

Second, in the relationship between Strategic Quality Planning and Human Resource Development & Management, the observed correlated cannot be reproduced even when the spurious effect of 0.165 from Leadership ($S_{\eta 4 \eta 3} = P_{\eta 3 \eta 1} * P_{\eta 4 \eta 1} = 0.296 * 0.557$ is added to the direct effect of 0.371. A coefficient of 0.343 ($\gamma_{\eta 4 \eta 3} - P_{\eta 4 \eta 3} - S_{\eta 4 \eta 3} = 0.879 - 0.371 - 0.165$), or 39.0 percent of observed correlation, remains unaccountable. This unanalyzed portion implies that a path leading to Human Resource Development & Management may be missing. Accordingly, a path pointing from Information & Analysis to Human Resource Development & Management may generate an additional direct effect to uncover the unanalyzed portion. Similarly, a path leading from Information & Analysis may be added to Management of Process Quality to explore the unexplained portion of 0.396 ($\gamma_{\eta 5 \eta 3} - P_{\eta 5 \eta 3} - I_{\eta 5 \eta 3} - S_{\eta 5 \eta 3} = 0.873 - 0.265 - 0.066 - 0.296 * 0.494$).

Third, the unexplained effects in Quality & Operational Results with respect to both Human Resource Development & Management and Management of Process Quality can be eliminated once a reciprocal relationship is specified between the two latter constructs ($\gamma_{\eta 6 \eta 4} = P_{\eta 6 \eta 4} + \gamma_{\eta 5 \eta 4} * P_{\eta 6 \eta 5} = 0.379 + 0.854 * 0.432 = 0.748$; $\gamma_{\eta 6 \eta 5} =$

$P_{\eta 6 \eta 5} + \gamma_{\eta 5 \eta 4} * P_{\eta 6 \eta 4} = 0.432 + 0.854 * 0.379 = 0.756$). Conceptually, this "looping causal effect" implies a synergetic coordination between Human Resource Development & Management and Management of Process Quality. This two-way interaction, in fact, has been implicitly discussed in the literature of production and operations management. For example, the participation of well-trained employees helps improve productivity by smoothing the production schedule (Garvin 1984b), which in turn results in a facilitated learning environment for an even more effective workforce. Deshpande et al. (1986) conducted an study on cooperative quality management system in which the benefit of such interacting effect was empirically supported.

The above numerical illustrations provide insight on the causal relationships that might exist in the empirical setting. It should be emphasized, however, that such theory trimming approach could not be construed as a substitute for a priori hypothesis testing. Grounded theoretical justification, followed by further empirical validation, is the necessary condition for the reformulation of plausible causal relationships.

Finally, we turn our focus on the relationships among Quality & Operational Results, Customer Focus &

Satisfaction, and Financial Performance. The direct effect of Quality & Operational Results on Customer Focus & Satisfaction is strongly supported in the structural model analysis. The high standardized path coefficient ($P_{\eta 8 \eta 7} = 0.983$, $p < 0.005$) and R^2 (0.965) show that Quality & Operational Results is the top indicator and determinant of Customer Focus & Satisfaction. In this study, however, one should be cautious in claiming that the provision of high quality products or services will lead to higher customer satisfaction in spite of the encouraging statistical results. The reason is that the instrument of Customer Focus & Satisfaction was developed to operationalize the underlying concepts from managers' perception rather than customers' perception. Takeuchi & Quelch (1983) cautioned that even well-designed, defect-free products may not fit customers' perception of high quality. Nevertheless, it is reasonable to assume that higher customer satisfaction can be achieved if management devotes efforts to identify customers' view of quality and establish good customer relationship. While this cannot be proved unless customer based data are available, the causal relationship may deem to be empirically supported on basis of existing theoretical justification. Future research that measures customer

satisfaction directly from customers' feedback is instrumental to ascertain whether there is actual relationship (compared with perceptual evaluation from managers) between quality performance and customer satisfaction.

For Financial Performance, both the direct effect from Customer Focus & Satisfaction and the indirect effect from Quality & Operational Results are statistically significant. Although the paths are empirically supported, only weak relationships are observed ($P_{\eta 8 \eta 7} = 0.154$, $p < 0.005$; $I_{\eta 8 \eta 6} = 0.151$, $p < 0.05$) and merely 2.4 percent of the observed variance in Financial Performance are explained. The result is not unexpected as other factors such as economic condition, changes in fashion and shifts in technology may be the more critical determinants of Financial Performance. Garvin (1991) argued that companies performing well in quality and customer satisfaction were far better positioned to recover from adverse condition. Thus, quality and customer satisfaction are strong predictors of long term survival and leading indicators of future profitability. This argument is consistent with the empirical methodology that R^2 scores are generally much

lower for cross-sectional regressions as opposed to time series regressions.

Overall, the highly statistically significant path coefficients and good R^2 values confirm the existence of proposed causal relationships and the outcome effectiveness of TQM implementation among the constructs. Thus, the results support predictive validity, that is, the variables taken as causes are good indicators and important determinants of the subsequent variables taken as effects.

This study fulfills several purposes from the standpoint of both academic research and managerial practice. In terms of research, this study demonstrates the first attempt in providing empirical validation for a holistic TQM model which serves well as the basis for further empirical work aiming at increasing the generalizability of the findings. Several plausible relationships are also suggested for reformulation of a more precise model in order to contribute to the evolving knowledge of TQM literature. From a practical standpoint, managers can use the measurement items developed in the model as a reference checklist for implementation and evaluation of TQM in their organizations. The quantitative justification of causal

relationships has practical significance to managers in directing improvement efforts to the determinant factors of TQM in achieving strategic competitive performance. Grounded theoretical benefits of applying TQM practices, in addition to the strong empirical validation, should encourage managers to better understand and more effectively embrace the adoption of TQM in their organizations.

CHAPTER VIII

CONCLUSION

Different conceptual approaches to quality management practices have emerged in the TQM literature, but research efforts in testing the proposed theories have not advanced beyond the presentation of anecdotal experience, single-company case study or fragmentary empirical work. This paper provides the first empirical validation for a holistic TQM model that integrates the organizational quality contextual variables, the seven MBNQA criteria, and financial performance measures.

The results of structural equation modeling confirm the theoretical causal relationships among the TQM constructs. The effectiveness of TQM arises from leadership effort towards the integral implementation of TQM in the operational system, which, when implemented, achieves higher customer satisfaction and more competitive performance through continuous improvement of product and service quality. Corporate support is essential in pervading TQM philosophy and motivating

organization's commitment and participation from top to bottom.

The instruments developed in the integrative model provide a comprehensive list of TQM elements for managers to identify and evaluate status of implementation of TQM in their organizations. The extent to which each construct contributes to outcome effectiveness helps managers prioritize quality management effort for strategic improvement in performance.

While the encouraging results have shed new light on the realistic effectiveness of TQM implementation in business practice, additional research is needed to further corroborate the empirical findings in this study. Replications that involve larger and more broadly based samples should increase the generalizability of the findings to establish cross-method validity. The suggested plausible relationships within the context of operational system should be explored for refinement of the model. Further, longitudinal studies can accomplish the task of building a dynamic model that specifies the reciprocal relationships and feedback mechanisms among the TQM practices. Other organizational controllables, in addition to quality improvement practices, should be incorporated to extend the potential instruments in

explaining and predicting financial performance. The role that reengineering plays in achieving dramatic improvement in performance, for example, is just beginning to draw the attention of quality management literature. The author hopes that this study will provide impetus for future research to contribute better practical business decisions in the now practitioner-dominated quality management literature.

Table 1: A Comparison of Quality Management Approaches of the Quality Gurus

Critical Factors	Deming	Juran	Crosby
Top Management Leadership	Create constancy of purpose toward quality and continuous improvement (Point 1). Adopt new philosophy towards defects and mistakes (Point 2) and modern methods of supervision e.g. coaching and participative management style (Point 7).	Top management is responsible for leadership in quality planning, control, and improvement policy. Create awareness of the need and opportunity for improvement.	Management commitment to quality improvement. Setting quality policy to match the goal. Raise the awareness of quality through the organization.
The Role of Quality Department	Define as a structure in top management to push the Deming principles (Point 14). Help to coordinate different departments (Point 9).	Mandate quality program and make it a part of every job description.	Establish quality councils and quality improvement teams consisting of quality professionals to share experiences and generate ideas.
Training	Use modern method of training on the job e.g. SPC (Point 6). Institute vigorous program for ongoing training (Point 13).	Training employees at all levels the use of appropriate tools to improve quality.	Train all employees to carry out their parts of quality improvement program.
Product/ Service Design	Not explicitly addressed	Product design emphasizing fitness for purpose and fitness for use. Produce products which can meet customers' needs.	Understand customers' requirements and incorporate them in product/service design.

Supplier Quality Management	Maintain long-term relationships with a few suppliers on basis of quality rather than price (Point 4).	Use statistical method like sampling plan for supplier management.	Not explicitly addressed.
Process Management	Use statistical process control in manufacturing process and incoming material (Point 3). Emphasizing teamwork in solving quality problems (Point 9).	Use control and breakthrough sequence (Juran's Quality Trilogy) for quality improvement. Minimizing total costs of quality by maintaining optimal conformance level.	Emphasize prevention to achieve zero defects. Take corrective actions and remove error causes to ensure conformance to specifications.
Quality Data & Reporting	Use statistical method to provide quality data and analysis for problem solving and continuous improvement in system (Point 5).	Quality information system for recording cost of quality and evaluating performance.	Establish measurements for quality in all activities. Evaluate costs of quality for identifying potential quality improvement
Employee Relations	Create employee fulfillment by removing all barriers to worker's pride of workmanship (Point 12). Eliminate numerical quota and focus on quality (Point 10). Continual development of personal intellectual enrichment for employees (Point 13). Drive out fears, encourage communication and mutual trust (Point 8).	Encouraging employee participation and teamwork, e.g. quality circle. Recognize employees on quality performance.	Encourage and recognize employee participation. Hold a Zero Defects Day to communicate organizational new performance standard. Help employees achieve their goals by removing obstacles.

Source: Modified from Saraph, J. V., Benson, P. G., and Schroeder, R. G., "An Instrument for Measuring the Critical Factors of Quality Management," Decision Sciences, 20, 4, Fall 1989, pp. 810-829.

Table 2: A Comparison of the Coverage of ISO 9001, ISO 9002, and ISO 9003

Coverage	ISO 9001	ISO 9002	ISO 9003
Management Responsibility	●	●	● (N)
Quality System	●	●	● (E)
Contract Review	●	●	● (N)
Design Control	●	○	○
Document and Data Control	●	●	● (N)
Purchasing	●	●	○
Purchaser Supplied Product	●	●	● (N)
Product Identification and Traceability	●	●	● (N)
Process Control	●	●	○
Inspection and Testing	●	●	⊙
Inspection, Measurement, and Test Equipment	●	●	● (E)
Inspection and Test Status	●	●	⊙
Control of Non-conforming Product	●	●	⊙
Corrective and Preventative Action	●	●	⊙
Handling, Storage, Packaging, and Delivery	●	●	● (E)
Quality Records	●	●	⊙
Internal Quality Audits	●	●	● (N)
Training	●	●	⊙
Servicing	●	● (N)	○
Statistical Techniques	●	●	⊙

Key:
● : Comprehensive coverage
⊙ : Mainly focus on final inspection
○ : Not covered
(N) : New clause in the 1994 revision
(E) : Extended in the 1994 revision

Table 3: Examination Categories, Items and Scoring Weights for the Malcolm Baldrige National Quality Award

Category (Category Score: 1000 Total)	Examination Item		Scoring Weight
Leadership (95 Total)	1.1)	Senior Executive Leadership	45
	1.2)	Management for Quality	25
	1.3)	Public Responsibly and Corporate Citizenship	25
Information & Analysis (75 Total)	2.1)	Scope and Management of Quality and Performance Data and Information	15
	2.2)	Competitive Comparisons and Benchmarking	20
	2.3)	Analysis and Uses of Company-level Data	40
Strategic Quality Planning (60 Total)	3.1)	Strategic Quality and Company Performance Planning Process	35
	3.2)	Quality and Performance Plans	25
Human Resource Development & Management (150 Total)	4.1)	Human Resource Planning and Management	20
	4.2)	Employee Involvement	40
	4.3)	Employee Education and Training	40
	4.4)	Employee Performance and Recognition	25
	4.5)	Employee Well-being and Satisfaction	25
Management of Process Quality (140 Total)	5.1)	Design and Introduction of Quality Products and Services	40
	5.2)	Process Management: Product and Service Production and Delivery Processes	35
	5.3)	Process Management: Business Processes and Support Services	30
	5.4)	Supplier Quality	20
	5.5)	Quality Assessment	15
Quality Results (180 Total)	6.1)	Product and Service Quality Results	70
	6.2)	Company Operational Results	50
	6.3)	Business Process and Support Service Results	25
	6.4)	Supplier Quality Results	35
Customer Focus & Satisfaction (300 Total)	7.1)	Customer Relationship Management	65
	7.2)	Commitment to Customers	15
	7.3)	Customer Satisfaction Determination	30
	7.4)	Customer Satisfaction Results	85
	7.5)	Customer Satisfaction Comparison	70
	7.6)	Customer Expectations, Current & Future	35

Source: "1993 Award Criteria, Malcolm Baldrige National Quality Award," U.S. Department of Commerce, Technology Administration, National Institute of Standards and Technology, Gaithersburg, MD., 1993.

Table 4: Profile of Past Quality Management Literature from 1970 to 1993

Orientation of Article	Frequency
Overview	27
Conceptual	107
Case study	56
Empirical	29
Analytical	6
Simulation	1
Total	**226**

Source: Partly adopted from Ahire, Sanjay L., Landeros, Robert, and Golhar, Damodar Y., "Total Quality Management: A Literature Review and an Agenda for Future Research," Production and Operations Management, 4, 3, 1995, pp. 277-307.

Table 5: Measurement Items of the 12 Constructs

Measurement Items
MANAGERIAL KNOWLEDGE
X1: I am familiar with various quality programs such as zero defects, quality circles, statistical process control, etc.
X2: I have read books and articles, attended seminars, or sought outside expertise or consultants in the quality area
X3: Overall, my knowledge and experience in the quality area is comparable to that of managers at similar levels in other companies.
CORPORATE SUPPORT FOR QUALITY
X4: Setting corporate goal in quality
X5: Rewarding corporate management for quality performance
X6: Having adequate corporate leadership for quality
X7: Considering quality as a key strategic opportunity by corporate management
X8: Emphasizing corporate quality throughout the organization
X9: Corporate management committed to quality
X10: Having progressive and innovative management
X11: Providing adequate resources to corporate management for quality improvement purpose
X12: Having appropriate corporate system, e.g. plants, equipment, systems for quality improvement purpose
PAST QUALITY PERFORMANCE
X13: Perceived my company's/division's quality performance over the past three years as favorable
X14: Are satisfied with my company's/division's quality performance over the past three years
MARKETPLACE ENVIRONMENT
X15: Demand quality
X16: The degree of competition faced by my company/division is high
X17: There is little barrier of entry into business

LEADERSHIP

Y1: Top management assumes responsibility for quality performance

Y2: Top management is evaluated for quality performance

Y3: Major department heads participate actively in quality improvement process

Y4: Top management has clear and specific goal and objectives for quality performance

Y5: Top management creates and sustains clear and visible quality values

Y6: Top management communicates quality goal and objectives throughout the organization

Y7: Adequate amount of review of quality issues in top management meetings

Y8: Management concerns about public responsibility

INFORMATION & ANALYSIS

Y9: Quality data and information are collected and managed regularly and systematically

Y10: Quality data and information are accessible to employees

Y11: Quality related competitive comparison and benchmarking are used for quality planning, evaluation and improvement

Y12: Quality data and information are analyzed and used as tools to manage quality

STRATEGIC QUALITY PLANNING

Y13: A strategic quality planning process addresses in detail how the company will pursue market leadership through providing superior quality products/services

Y14: Quality plan and goal are comprehensive within the organization

HUMAN RESOURCE DEVELOPMENT & MANAGEMENT

Y15: Employees contribute effectively in employee involvement programs such as quality circle

Y16: Employees are responsible in producing quality products/services

Y17: Constant awareness of the importance of quality among employees

Y18: Employees participate in quality decisions

Y19: Providing specific work-skills training and quality education for employees to meet the quality objectives associated with their responsibilities

Y20: Employees receive training in the "total quality concept", i.e. the philosophy of company-wide responsibility for quality

Y21: Providing team building and group dynamics training for employees

Y22: Training employees basic statistical process control techniques

Y23: Adequate resources (staffs, system, facilities, funding) are available for employee training

Y24: Employees receive feedback on their quality performance

Y25: Employees are recognized for superior quality performance

Y26: Employees are provided with a comfortable working environment

Y27: Overall, employees are satisfied with the company

MANAGEMENT OF PROCESS QUALITY

Y28: Quality practice reflects an emphasis upon design

Y29: Quality practice reflects an emphasis upon conformance

Y30: Design, manufacturing and other affected departments work closely together in the product/service development process

Y31: New products/services design are thoroughly reviewed before introduction

Y32: Specifications and procedures of products/services are clearly stated

Y33: Acceptance sampling and inspection are used to ensure conformance

Y34: Employing statistical process control to control processes

Y35: Preventive equipment maintenance are carried out to guarantee stable work schedule

Y36: Production process is highly automated

Y37: Workers perform self-inspection of their works

Y38: Various quality related tests, e.g. reliability, feasibility and liability tests are performed to assess quality and safety of products/services

Y39: Quality is emphasized and considered as salable attribute

Y40: Devote effort to achieve continuous improvement of processes

Y41: Instruction manual on production process are well documented and distributed to employees

Y42: Process design is "fool-proof" to minimize the chances of employee errors

Y43: Production process is well supported by periphery functions

Y44: Suppliers are involved in the product development process

Y45: Suppliers are rated and selected based on quality rather than price

Y46: Reliance on reasonably few dependable suppliers

Y47: Long-term contract and commitment are offered to suppliers

Y48: Technical assistance and education are provided to suppliers

QUALITY & OPERATIONAL PERFORMANCE
Y49: Average percent of items (or services) defective in our processes
Y50: Internal waste/scrap cost as a percent of dollar sales
Y51: Returns and warranty or adjustment costs as a percent of dollar sales
Y52: Rework as a percent of dollar sales
Y53: Training and development expenditures as a percent of dollar sales
CUSTOMER FOCUS & SATISFACTION
Y54: Customers' opinions and views regarding their needs and requirements are actively sought
Y55: Customer relationship and customer complaints are handled cautiously
Y56: Customers regularly and formally receive customer satisfaction questionnaires
Y57: Customer satisfaction and service standards are compared with other companies in the same industry
FINANCIAL PERFORMANCE
Y58: Last year's net profit as a percent of dollar sales
Y59: The past three years' net profit as a percent of dollar sales
Y60: Last year's return on asset, i.e. , net profit divided by assets
Y61: The past three years' return on asset, i.e. , net profit divided by assets
Y62: Last year's average percent sales growth
Y63: The past three years' average percent sales growth

Table 6: The Seven MBNQA Criteria and the Corresponding Critical Factors of Quality Management

MBNQA Criteria	Corresponding Critical Factors of Quality Management (Saraph et al. 1989)
Leadership	The Role of Top Management Leadership
Information & Analysis	Quality Data & Reporting
Strategic Quality Planning	The Role of Quality Department
Human Resource Development & Management	Training Employee Relation
Management of Process Quality	Product/Service Design Supplier Quality Management Process Management
Quality & Operational Results	Not Addressed
Customer Focus & Satisfaction	Not Addressed

Table 7: Responses Received by Source

Organization	Number of Questionnaires sent out	Number of Questionnaires returned	Response Rate (%)
CGCC	1,200	94	7.8
VTC	1,000	88	8.8
ISO 9000 Certified Company	480	152	31.7
Diploma Course	116	100	86.2
Total	**2,796**	**434**	**15.5**

Table 8: Respondent Profile by Major Industry Groups

Industry Major Groups	Number of Responses
Primary Production	2
Food, beverages and tobacco	10
Wearing apparel	4
Textiles	7
Furniture and household goods	0
Paper products and printing	9
Chemical products	9
Rubber and plastic products	11
Non-metallic mineral products	2
Metal products	7
Electrical and electronic products	55
Office, accounting and computing machinery	8
Machinery, equipment and apparatus	12
Precious instrument, clocks and watches, optical goods	8
Wholesale, retail and import/export trades	31
Tourism, restaurants and hotels, catering	12
Community, social and personal services	14
Finance, insurance, real estate and other business services	65
Transport, storage and communication	20
Construction	44
Professional services	23
Others	48
Total	**401**

Table 9: Company Demographics of the Sampled Firms

Company Demographics	Response
Nature of Company	
Manufacturing Industry	124
Service Industry	226
Both Manufacturing and Service	51
Average Number of Years of Establishment	25.3
Average Number of Employees	1,533.4
Number of Small Company	151
Number of Medium Company	153
Number of Large Company	97
Average Annual Employee Turnover Rate	16.0
Average Sales Last Year	$ 1,282,000,000

Note: Company size is defined as below according to the Hong Kong Census and Statistics Department:

Classification Group	Number of Employees
Manufacturing Industry	
Small Company	Below 200
Medium Company	200 - 1999
Large Company	Above 2000
Service Industry	
Small Company	Below 100
Medium Company	100 - 499
Large Company	Above 500

Table 10: Quality Demographics of the Sampled Firms

Quality Demographics	Response
Number of Companies with Quality Department	182
Average Year of Establishment	7.92
Average Number of Staff	18.80
Number of Companies without Quality Department	219
Number of ISO 9000 Certified Companies	157
ISO 9001	56
ISO 9002	101
ISO 9003	1
Average Year of Certification	2.42
Number of Non-ISO 9000 Certified Companies	244

Table 11: Results of MANOVA

Treatment	F Statistic	Hypo. df	Error df	p Value
Full Way Interaction	0.798	84	256	0.887
Source of Sample	1.062	252	774	0.272
Nature of Industry	1.184	84	256	0.160
Company Size	0.715	168	514	0.995
Quality Department	0.891	84	256	0.730
ISO 9000	0.959	84	256	0.580

Note: F statistics show consistent and similar results for Pillais, Hotellings, Wilks and Roys but only the statistics for Pillais are reported here.

Treatment

Source of Sample

- CGCC
- VTC
- ISO 9000 Certified Companies
- Diploma Course

Nature of Industry

- Manufacturing Industry
- Service Industry

Company Size

- Small Company
- Medium Company
- Large Company

Quality Department

- Presence
- Absence

ISO 9000

- Certified
- Not Certified

Table 12: A Cross Tabulation of ISO 9000 Certification with Nature of Industry

Count (Row %) (Column %)	With ISO 9000	Without ISO 9000	Row Total (Row Total %)
Manufacturing Industry	104 (59.4) (66.2)	71 (41.6) (29.1)	175 (43.6)
Service Industry	53 (23.5) (33.8)	173 (76.5) (70.9)	226 (56.4)
Column Total (Column Total %)	157 (39.2)	244 (60.8)	401 (100.0)

$\chi^2 = 53.59$
df = 1
p = 0.0000

Table 13: A Cross Tabulation of ISO 9000 Certification with Presence of Quality Department

Count (Row %) (Column %)	With ISO 9000	Without ISO 9000	Row Total (Row Total %)
With Quality Department	117 (64.3) (74.5)	65 (35.7) (26.6)	182 (45.4)
Without Quality Department	40 (18.3) (25.5)	179 (81.7) (73.4)	219 (54.6)
Column Total (Column Total %)	157 (39.2)	244 (60.8)	401 (100.0)

$\chi^2 = 88.36$
df = 1
p = 0.0000

Table 14: A Cross Tabulation of ISO 9000 Certification with Selected Major Industry Groups

Count (Row %)	With ISO 9000	Without ISO 9000	Row Total
Electrical and electronic products	40 (72.7)	15 (27.3)	55
Construction	34 (77.3)	10 (22.7)	44
Wholesale, retail and import/export trades	5 (16.1)	26 (83.9)	31
Finance, Insurance, real estate and other business services	4 (6.2)	61 (93.8)	65

Note: Only major industry groups with sample size over 30 are reported.

Table 15: Performance Measures of the Sampled Firms

Construct	Measurement Items	Percent
Quality & Operational Results	Average % of items defective	8.65
	Costs of quality (as % of sales)	
	Internal waste/scrap cost	8.80
	Returns and warranty or adjustment costs	5.78
	Rework	7.84
	Training and development	6.24
	Total costs of quality	28.66
Financial Performance	Last year's net profit as a % of sales	14.90
	Past 3 years' net profit as a % of sales	16.81
	Last year's return on asset	20.53
	Past 3 years' return on asset	21.18
	Last year's average % sales growth	15.89
	Past 3 years' average % sales growth	21.75

Table 16: Industry Adjustment Terms of Return on Sales, Return on Asset, and Sales Growth

Industry Major Groups	Population Mean of ROS/ROA	Adjustment Term of ROS/ROA	Population Mean of Sales Growth	Adjustment Term of Sales Growth
Primary Production	12.35	0.74	12.23	1.65
Food, beverages and tobacco	19.77	8.16	-5.14	-15.72
Wearing apparel	7.45	-4.16	-12.93	-23.51
Textiles	8.10	-3.51	-5.68	-16.26
Furniture and household goods	9.37	-2.24	-27.22	-37.80
Paper products and printing	17.49	5.88	21.71	11.13
Chemical products	14.02	2.41	13.58	3.00
Rubber and plastic products	14.43	2.82	-30.32	-40.90
Non-metallic mineral products	10.31	-1.30	4.86	-5.72
Metal products	11.10	-0.51	-3.71	-14.29
Electrical and electronic products	19.75	8.14	0.21	-10.37
Office, accounting and computing machinery	8.83	-2.78	-9.84	-20.42
Machinery, equipment and apparatus	15.33	3.72	-8.06	18.64
Precious instrument, clocks and watches, optical goods	7.81	-3.80	-12.22	-22.8
Wholesale, retail and import/export trades	5.25	-6.36	11.05	0.47
Tourism, restaurants and hotels, catering	10.68	-0.93	9.14	-1.44
Community, social and personal services	19.00	7.39	25.33	14.75
Finance, insurance, real estate and other business services	65.80	54.19	22.91	12.33
Transport, storage and communication	17.48	5.87	15.34	4.76
Construction	6.30	-5.31	22.89	12.31
Professional services	20.47	8.86	9.49	-1.09
Others	15.76	4.15	13.43	2.85

Source of population mean: 1995 Publications of Hong Kong Government Statistics and Census Department

Note: Last year figures and past three years' figures are subject to the same respective adjustment term.
ROS is used as a proxy for ROA since the population mean of ROA is not available.

Table 17: Results of Construct Reliability and Within-scale Factor Analysis

Constructs	Reliability (α)	Eigenvalue	Range of unifactorial loading	Percent of variation explained
Managerial Knowledge	0.859	2.34	0.72 - 0.81	78.0
Corporate Support for Quality	0.925	4.38	0.66 - 0.78	73.0
Past Quality Performance	0.898	1.82	0.91	90.8
Marketplace Environment	0.358	N.A.	N.A.	N.A.
Leadership	0.920	3.78	0.67 - 0.83	75.7
Information & Analysis	0.858	2.81	0.60 - 0.77	70.2
Strategic Quality Planning	0.826	1.70	0.85	85.2
Human Resource Development & Management	0.923	5.20	0.56 - 0.76	65.0
Management of Process Quality	0.910	5.27	0.53 - 0.63	58.5
Quality & Operational Results	0.847	2.75	0.61 - 0.75	68.7
Customer Focus & Satisfaction	0.771	2.42	0.53 - 0.72	60.5
Financial Performance	0.908	3.14	0.72 - 0.85	78.4

Note: The construct of Marketplace Environment was excluded after analysis of construct reliability.

Table 18: Fit Statistics of the Overall Total Quality Management Model

Null Model	
$\chi 2$	97665.919
df	1275
$\chi 2$/df	76.60
TQM Model	
$\chi 2$	2170.193
df	1205
$\chi 2$/df	1.80
Root Mean Square Residual (RMSR)	0.064
Goodness of Fit Index (GFI)	0.980
Adjusted Goodness of Fit Index (AGFI)	0.978
Parsimony Goodness of Fit Index (PGFI)	0.890
Normed Fit Index (NFI)	0.978
Non-Normed Fit Index (NNFI)	0.989
Parsimony Normed Fit Index (PNFI)	0.924
Comparative Fit Index (CFI)	0.990
Incremental Fit Index (IFI)	0.990
Relative Fit Index (RFI)	0.976

Table 19: Results of the Measurement Model of the Total Quality Management Model

Measurement Items	λ	R^2
Managerial Knowledge (Construct Mean = 3.414)		
X1: Familiar with various quality programs such as zero defects, quality circles, statistical process control, etc.	0.828	0.685
X2: I have read books and articles, attended seminars, or sought outside expertise or consultants in the quality area	0.940	0.883
X3: Overall, my knowledge and experience in the quality area is comparable to that of managers at similar levels in other companies	0.761	0.579
Corporate Support for Quality (Construct Mean = 2.883)		
X6: Having adequate corporate leadership for quality	0.825	0.680
X7: Considering quality as a key strategic opportunity by corporate management	0.775	0.601
X8: Emphasizing corporate quality throughout the organization	0.804	0.647
X9: Corporate management committed to quality	0.840	0.706
X11: Providing adequate resources to corporate management for quality improvement purpose	0.896	0.802
X12: Having appropriate corporate system, e.g. plants, equipment, systems for quality improvement purpose	0.889	0.790
Past Quality Performance (Construct Mean = 2.739)		
X13: Perceived my company's/division's quality performance over the past three years as favorable	0.948	0.900
X14: Are satisfied with my company's/division's quality performance over the past three years	0.918	0.844

Leadership (Construct Mean = 3.023)		
Y3: Major department heads participate actively in quality improvement process	0.856	0.732
Y4: Top management has clear and specific goal and objectives for quality performance	0.876	0.768
Y5: Top management creates and sustains clear and visible quality values	0.852	0.726
Y6: Top management communicates quality goal and objectives throughout the organization	0.877	0.770
Y7: Adequate amount of review of quality issues in top management meetings	0.839	0.704
Information & Analysis (Construct Mean = 3.303)		
Y9: Quality data and information are collected and managed regularly and systematically	0.846	0.715
Y10: Quality data and information are accessible to employees	0.755	0.571
Y11: Quality related competitive comparison and benchmarking are used for quality planning, evaluation and improvement	0.745	0.555
Y12: Quality data and information are analyzed and used as tools to manage quality	0.845	0.714
Strategic Quality Planning (Construct Mean = 3.344)		
Y13: A strategic quality planning process addresses in detail how the company will pursue market leadership through providing superior quality products/services	0.822	0.675
Y14: Quality plan and goal are comprehensive within the organization	0.889	0.790

Human Resource Development & Management (Construct Mean = 3.616)		
Y15: Employees contribute effectively in employee involvement programs such as quality circle	0.829	0.688
Y17: Constant awareness of the importance of quality among employees	0.827	0.684
Y18: Employees participate in quality decisions	0.762	0.581
Y19: Providing specific work-skills training and quality education for employees to meet the quality objectives associated with their responsibilities	0.820	0.672
Y20: Employees receive training in the "total quality concept", i.e. the philosophy of company-wide responsibility for quality	0.812	0.660
Y21: Providing team building and group dynamics training for employees	0.785	0.616
Y22: Training employees basic statistical process control techniques	0.742	0.551
Y23: Adequate resources (staffs, system, facilities, funding) are available for employee training	0.768	0.590
Management of Process Quality (Construct Mean = 3.083)		
Y28: Quality practice reflects an emphasis upon design	0.725	0.526
Y29: Quality practice reflects an emphasis upon conformance	0.701	0.491
Y30: Design, manufacturing and other affected departments work closely together in the product/service development process	0.714	0.509
Y31: New products/services design are thoroughly reviewed before introduction	0.694	0.482
Y32: Specifications and procedures of products/services are clearly stated	0.777	0.604
Y34: Employing statistical process control to control processes	0.762	0.580
Y35: Preventive equipment maintenance are carried out to guarantee stable work schedule	0.745	0.555
Y38: Various quality related tests, e.g. reliability, feasibility and liability tests are performed to assess quality and safety of products/services	0.760	0.577
Y40: Devote effort to achieve continuous improvement of processes	0.856	0.733

Quality & Operational Performance (Construct Mean = 7.728%)		
Y49: Average percent of items (or services) defective in our processes	0.790	0.624
Y50: Internal waste/scrap cost as a percent of dollar sales	0.762	0.581
Y51: Returns and warranty or adjustment costs as a percent of dollar sales	0.736	0.541
Y52: Rework as a percent of dollar sales	0.756	0.571
Customer Focus & Satisfaction (Construct Mean = 2.980%)		
Y54: Customers' opinions and views regarding their needs and requirements are actively sought	0.813	0.661
Y55: Customer relationship and customer complaints are handled cautiously	0.686	0.471
Y56: Customers regularly and formally receive customer satisfaction questionnaires	0.691	0.478
Y57: Customer satisfaction and service standards are compared with other companies in the same industry	0.696	0.484
Financial Performance (Construct Mean = 8.232%)		
Y58: Last year's net profit as a percent of dollar sales	0.858	0.737
Y59: The past three years' net profit as a percent of dollar sales	0.751	0.564
Y60: Last year's return on asset, i.e. , net profit divided by assets	0.821	0.674
Y61: The past three years' return on asset, i.e. , net profit divided by assets	0.943	0.889

Note: All estimates of standardized factor loadings (λ) are statistically significant at $p < 0.005$
Construct means are computed by the factor loading weighted averages of the corresponding measurement items

Table 20: Results of the Structural Model of the Total Quality Management Model

Dependent Variable	R^2	Error Variance	Independent Variable	Path Coeff.
Leadership	0.881	0.119	Managerial Knowledge	0.048^b
			Corporate Support for Quality	0.849^a
			Past Quality Performance	0.106^a
Information & Analysis	0.782	0.218	Leadership	0.884^a
Strategic Quality Planning	0.939	0.062	Leadership	0.296^c
			Information & Analysis	0.697^a
Human Resource Development & Management	0.825	0.175	Leadership	0.557^a
			Strategic Quality Planning	0.371^a
Management of Process Quality	0.826	0.174	Leadership	0.494^a
			Strategic Quality Planning	0.265^a
			Human Resource Development & Management	0.178^a
Quality & Operational Results	0.608	0.392	Human Resource Development & Management	0.377^a
			Management of Process Quality	0.433^a
Customer Focus & Satisfaction	0.950	0.050	Quality & Operational Results	0.975^a
Financial Performance	0.043	0.957	Quality & Operational Results	0.752^e
			Customer Focus & Satisfaction	-0.610^e

Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Table 21: Correlation Matrix of the Constructs of the Total Quality Management Model

Correlation Matrix (γ)	Managerial Knowledge	Corporate Support for Quality	Past Quality Performance	Leadership	Information & Analysis	Strategic Quality Planning	Human Resource Development & Management	Management of Process Quality	Quality & Operational Results	Customer Focus & Satisfaction	Financial Performance
Managerial Knowledge	1.000										
Corporate Support for Quality	0.449	1.000									
Past Quality Performance	0.232	0.593	1.000								
Leadership	0.454	0.934	0.621	1.000							
Information & Analysis	0.402	0.826	0.549	0.884	1.000						
Strategic Quality Planning	0.414	0.852	0.566	0.913	0.959	1.000					
Human Resource Development & Management	0.407	0.836	0.556	0.895	0.848	0.879	1.000				
Management of Process Quality	0.407	0.837	0.556	0.896	0.842	0.873	0.854	1.000			
Quality & Operational Results	0.329	0.677	0.450	0.725	0.684	0.709	0.746	0.755	1.000		
Customer Focus & Satisfaction	0.321	0.660	0.439	0.707	0.667	0.691	0.728	0.736	0.975	1.000	
Financial Performance	0.052	0.106	0.071	0.114	0.107	0.111	0.117	0.118	0.157	0.123	1.000

Table 22: Results of Path Analysis of the Total Quality Management Model

P: Direct Effect (%) I: Indirect Effect (%) U: Unexplained Effect (%) γ: Observed Correlation		EFFECT OF INDEPENDENT VARIABLES									
		Managerial Knowledge	Corporate Support for Quality	Past Quality Performance	Leadership	Information & Analysis	Strategic Quality Planning	Human Resource Development & Management	Management of Process Quality	Quality & Operational Results	Customer Focus & Satisfaction
ON DEPENDENT VARIABLES	Leadership	0.048[b](10.6%) N.A. 0.406(89.4%) 0.454	0.849[a](90.9%) N.A. 0.085(9.1%) 0.934	0.106[a](17.1%) N.A. 0.515(82.9%) 0.621							
	Information & Analysis	N.A. 0.042[d](10.4%) 0.360(89.6%) 0.402	N.A. 0.751[a](90.9%) 0.075(9.1%) 0.826	N.A. 0.094[a](17.1%) 0.455(82.9%) 0.549	0.884[a](100%) N.A. 0.000(0.0%) 0.884						
	Strategic Quality Planning	N.A. 0.044[d](10.6%) 0.370(89.4%) 0.414	N.A. 0.755[a](88.6%) 0.097(11.4%) 0.852	N.A. 0.097[a](17.1%) 0.469(82.9%) 0.566	0.296[c](32.4%) 0.616[a](67.5%) 0.001(0.1%) 0.913	0.697[a](72.7%) N.A. 0.262(27.3%) 0.959					
	Human Resource Development & Management	N.A. 0.043[d](10.6%) 0.364(89.4%) 0.407	N.A. 0.761[a](91.0%) 0.075(9.0%) 0.836	N.A. 0.095[a](17.1%) 0.461(82.9%) 0.556	0.557[a](62.2%) 0.338[a](37.8%) 0.000(0.0%) 0.895	N.A. 0.258[a](30.4%) 0.590(69.6%) 0.848	0.371[a](42.2%) N.A. 0.508(57.8%) 0.879				
	Management of Process Quality	N.A. 0.043[d](10.6%) 0.364(89.4%) 0.407	N.A. 0.761[a](91.0%) 0.076(9.0%) 0.837	N.A. 0.095[a](17.1%) 0.461(82.9%) 0.556	0.494[a](55.1%) 0.401[a](44.9%) 0.001(0.0%) 0.896	N.A. 0.231[c](27.4%) 0.611(72.6%) 0.842	0.265[a](30.3%) 0.066[c](7.6%) 0.542(62.1%) 0.873	0.178[a](20.8%) N.A. 0.676(79.2%) 0.854			
	Quality & Operational Results	N.A. 0.035[d](10.6%) 0.294(89.4%) 0.329	N.A. 0.616[a](91.0%) 0.061(9.0%) 0.677	N.A. 0.077[a](17.1%) 0.373(82.9%) 0.450	N.A. 0.725[a](100%) 0.000(0.0%) 0.725	N.A. 0.197[b](28.8%) 0.487(71.2%) 0.684	N.A. 0.283[b](40.0%) 0.426(60.0%) 0.709	0.377[a](50.7%) 0.077[d](10.3%) 0.292(39.0%) 0.746	0.433[a](57.4%) N.A. 0.322(42.6%) 0.755		
	Customer Focus & Satisfaction	N.A. 0.034[d](10.6%) 0.287(89.4%) 0.321	N.A. 0.600[a](90.9%) 0.060(9.1%) 0.660	N.A. 0.075[a](16.7%) 0.374(83.3%) 0.449	N.A. 0.707[a](100%) 0.000(0.0%) 0.707	N.A. 0.192[a](28.8%) 0.475(71.2%) 0.667	N.A. 0.276[a](39.9%) 0.415(60.1%) 0.691	N.A. 0.442[a](60.7%) 0.286(39.3%) 0.728	N.A. 0.422[a](57.3%) 0.314(42.7%) 0.736	0.975[a](100%) N.A. 0.000(0.0%) 0.975	
	Financial Performance	N.A. 0.005[d](9.6%) 0.047(90.4%) 0.052	N.A. 0.097[c](91.5%) 0.009(8.5%) 0.106	N.A. 0.012[c](16.9%) 0.059(83.1%) 0.071	N.A. 0.114[c](100%) 0.000(0.0%) 0.114	N.A. 0.031[d](29.0%) 0.076(71.0%) 0.107	N.A. 0.044[d](39.6%) 0.067(60.4%) 0.111	N.A. 0.071[c](61.7%) 0.046(39.3%) 0.117	N.A. 0.068[c](57.6%) 0.050(42.4%) 0.118	0.752[c](479%) -0.595[e](-379%) 0.000(0.0%) 0.157	-0.610[c](-496%) N.A. 0.733(596%) 0.123

Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Table 23: Fit Statistics of the Overall Reformulated Total Quality Management Model

Null Model	
$\chi 2$	97665.919
df	1275
$\chi 2$/df	76.60
Reformulated TQM Model	
$\chi 2$	2172.923
df	1206
$\chi 2$/df	1.80
Root Mean Square Residual (RMSR)	0.064
Goodness of Fit Index (GFI)	0.980
Adjusted Goodness of Fit Index (AGFI)	0.978
Parsimony Goodness of Fit Index (PGFI)	0.891
Normed Fit Index (NFI)	0.978
Non-Normed Fit Index (NNFI)	0.989
Parsimony Normed Fit Index (PGFI)	0.925
Comparative Fit Index (CFI)	0.990
Incremental Fit Index (IFI)	0.990
Relative Fit Index (RFI)	0.976

Table 24: Results of the Structural Model of the Reformulated Total Quality Management Model

Dependent Variable	R^2	Error Variance	Independent Variable	Path Coeff.
Leadership	0.881	0.119	Managerial Knowledge	0.048^b
			Corporate Support for Quality	0.850^a
			Past Quality Performance	0.106^a
Information & Analysis	0.782	0.218	Leadership	0.884^a
Strategic Quality Planning	0.939	0.061	Leadership	0.296^b
			Information & Analysis	0.697^a
Human Resource Development & Management	0.825	0.175	Leadership	0.557^a
			Strategic Quality Planning	0.371^a
Management of Process Quality	0.826	0.174	Leadership	0.494^a
			Strategic Quality Planning	0.265^a
			Human Resource Development & Management	0.179^a
Quality & Operational Results	0.610	0.390	Human Resource Development & Management	0.379^a
			Management of Process Quality	0.432^a
Customer Focus & Satisfaction	0.965	0.035	Quality & Operational Results	0.983^a
Financial Performance	0.024	0.976	Customer Focus & Satisfaction	0.154^a

Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Table 25: Correlation Matrix of the Constructs of the Reformulated Total Quality Management Model

Correlation Matrix (γ)	Managerial Knowledge	Corporate Support for Quality	Past Quality Performance	Leadership	Information & Analysis	Strategic Quality Planning	Human Resource Development & Management	Management of Process Quality	Quality & Operational Results	Customer Focus & Satisfaction	Financial Performance
Managerial Knowledge	1.000										
Corporate Support for Quality	0.449	1.000									
Past Quality Performance	0.232	0.593	1.000								
Leadership	0.454	0.934	0.621	1.000							
Information & Analysis	0.402	0.826	0.549	0.884	1.000						
Strategic Quality Planning	0.414	0.852	0.566	0.913	0.959	1.000					
Human Resource Development & Management	0.407	0.836	0.556	0.895	0.848	0.879	1.000				
Management of Process Quality	0.407	0.836	0.556	0.896	0.842	0.873	0.854	1.000			
Quality & Operational Results	0.330	0.679	0.451	0.727	0.686	0.710	0.748	0.756	1.000		
Customer Focus & Satisfaction	0.324	0.667	0.443	0.714	0.674	0.698	0.735	0.743	0.983	1.000	
Financial Performance	0.050	0.103	0.068	0.110	0.104	0.108	0.113	0.114	0.151	0.154	1.000

Table 26: Results of Path Analysis of the Reformulated Total Quality Management Model

P: Direct Effect (%) I: Indirect Effect (%) U: Unexplained Effect (%) γ: Observed Correlation		EFFECT OF INDEPENDENT VARIABLES									
		Managerial Knowledge	Corporate Support for Quality	Past Quality Performance	Leadership	Information & Analysis	Strategic Quality Planning	Human Resource Development & Management	Management of Process Quality	Quality & Operational Results	Customer Focus & Satisfaction
ON DEPENDENT VARIABLES	Leadership	0.048[b](10.6%) N.A. 0.406(89.4%) 0.454	0.850[a](91.0%) N.A. 0.084(9.0%) 0.934	0.106[a](17.1%) N.A. 0.515(82.9%) 0.621							
	Information & Analysis	N.A. 0.042[d](10.4%) 0.360(89.6%) 0.402	N.A. 0.751[a](90.9%) 0.075(9.1%) 0.826	N.A. 0.094[a](17.1%) 0.455(82.9%) 0.549	0.884[a](100%) N.A. 0.000(0.0%) 0.884						
	Strategic Quality Planning	N.A. 0.044[d](10.6%) 0.370(89.4%) 0.414	N.A. 0.775[a](91.0%) 0.077(9.0%) 0.852	N.A. 0.097[a](17.1%) 0.469(82.9%) 0.566	0.296[b](32.4%) 0.616[a](67.5%) 0.001(0.1%) 0.913	0.697[a](72.7%) N.A. 0.262(27.3%) 0.959					
	Human Resource Development & Management	N.A. 0.043[d](10.6%) 0.364(89.4%) 0.407	N.A. 0.761[a](91.0%) 0.075(9.0%) 0.836	N.A. 0.095[a](17.1%) 0.461(82.9%) 0.556	0.557[a](62.2%) 0.338[a](37.8%) 0.000(0.0%) 0.895	N.A. 0.258[a](30.4%) 0.590(69.6%) 0.848	0.371[a](42.2%) N.A. 0.508(57.8%) 0.879				
	Management of Process Quality	N.A. 0.043[d](10.6%) 0.364(89.4%) 0.407	N.A. 0.761[a](91.0%) 0.075(9.0%) 0.836	N.A. 0.095[a](17.1%) 0.461(82.9%) 0.556	0.494[a](55.1%) 0.402[a](44.9%) 0.000(0.0%) 0.896	N.A. 0.231[c](27.4%) 0.611(72.6%) 0.842	0.265[a](30.3%) 0.066[c](7.6%) 0.542(62.1%) 0.873	0.179[a](21.0%) N.A. 0.675(79.0%) 0.854			
	Quality & Operational Results	N.A. 0.035[d](10.6%) 0.295(89.4%) 0.330	N.A. 0.617[a](90.9%) 0.062(9.1%) 0.679	N.A. 0.077[a](17.1%) 0.374(82.9%) 0.451	N.A. 0.727[a](100%) 0.000(0.0%) 0.727	N.A. 0.198[b](28.9%) 0.488(71.1%) 0.686	N.A. 0.284[b](40.0%) 0.426(60.0% 0.710	0.379[a](50.7%) 0.077[d](10.3%) 0.292(39.0%) 0.748	0.432[a](57.1%) N.A. 0.324(42.9%) 0.756		
	Customer Focus & Satisfaction	N.A. 0.034[d](10.5%) 0.290(89.5%) 0.324	N.A. 0.606[a](90.9%) 0.061(9.1%) 0.667	N.A. 0.076[a](17.2%) 0.367(82.8%) 0.443	N.A. 0.714[a](100%) 0.000(0.0%). 0.714	N.A. 0.194[a](28.8%) 0.480(71.2%) 0.674	N.A. 0.279[a](40.0%) 0.419(60.0%) 0.698	N.A. 0.488[a](61.0%) 0.287(39.0%) 0.735	N.A. 0.425[a](57.2%) 0.318(42.8%) 0.743	0.983[a](100.0%) N.A. 0.000(0.0%) 0.983	
	Financial Performance	N.A. 0.005[d](10.0%) 0.045(90.0%) 0.050	N.A. 0.093[c](90.3%) 0.010(9.7%) 0.103	N.A. 0.012[c](17.6%) 0.056(82.4%) 0.068	N.A. 0.110[c](100%) 0.000(0.0%) 0.110	N.A. 0.030[d](28.8%) 0.074(71.2%) 0.104	N.A. 0.043[d](39.8%) 0.065(60.2%) 0.108	N.A. 0.069[c](61.1%) 0.044(38.9%) 0.113	N.A. 0.065[c](57.0%) 0.049(43.0%) 0.114	N.A. 0.151[c](100.0%) 0.000(0.0%) 0.151	0.154[a](100.0%) N.A. 0.000(0.0%) 0.154

Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Figure 1: Path Diagram of the Conceptual Total Quality Management Model

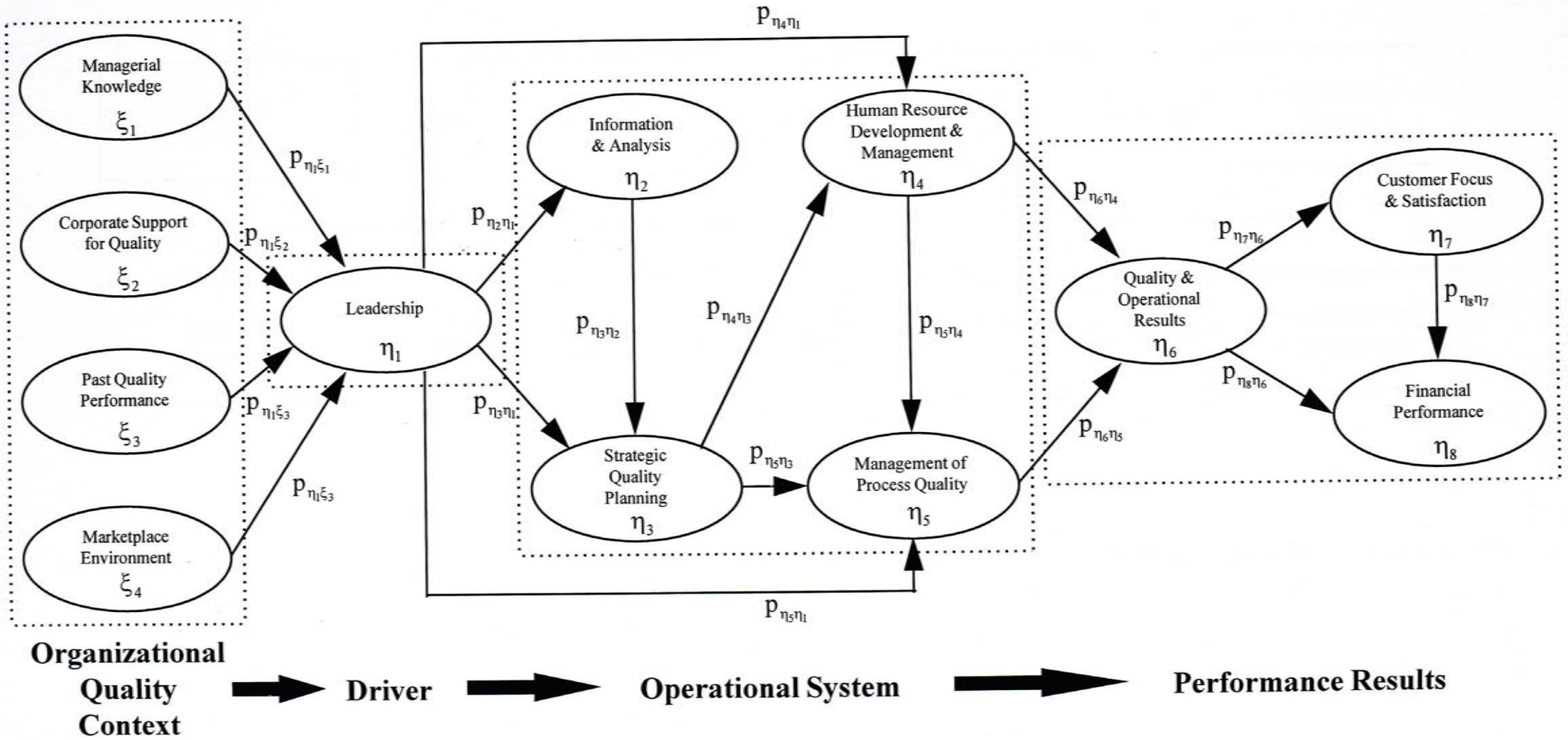
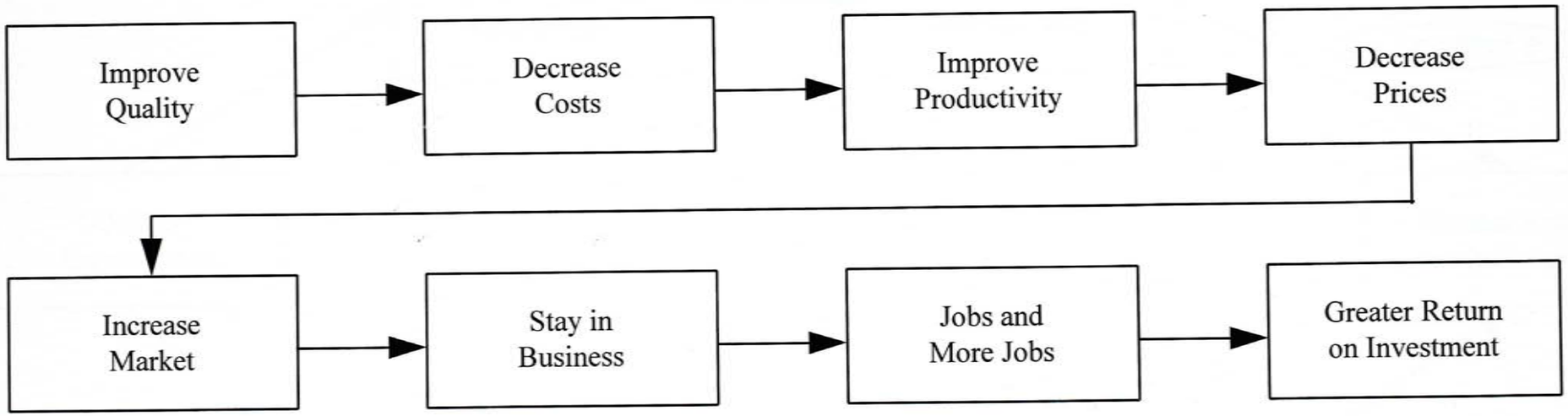
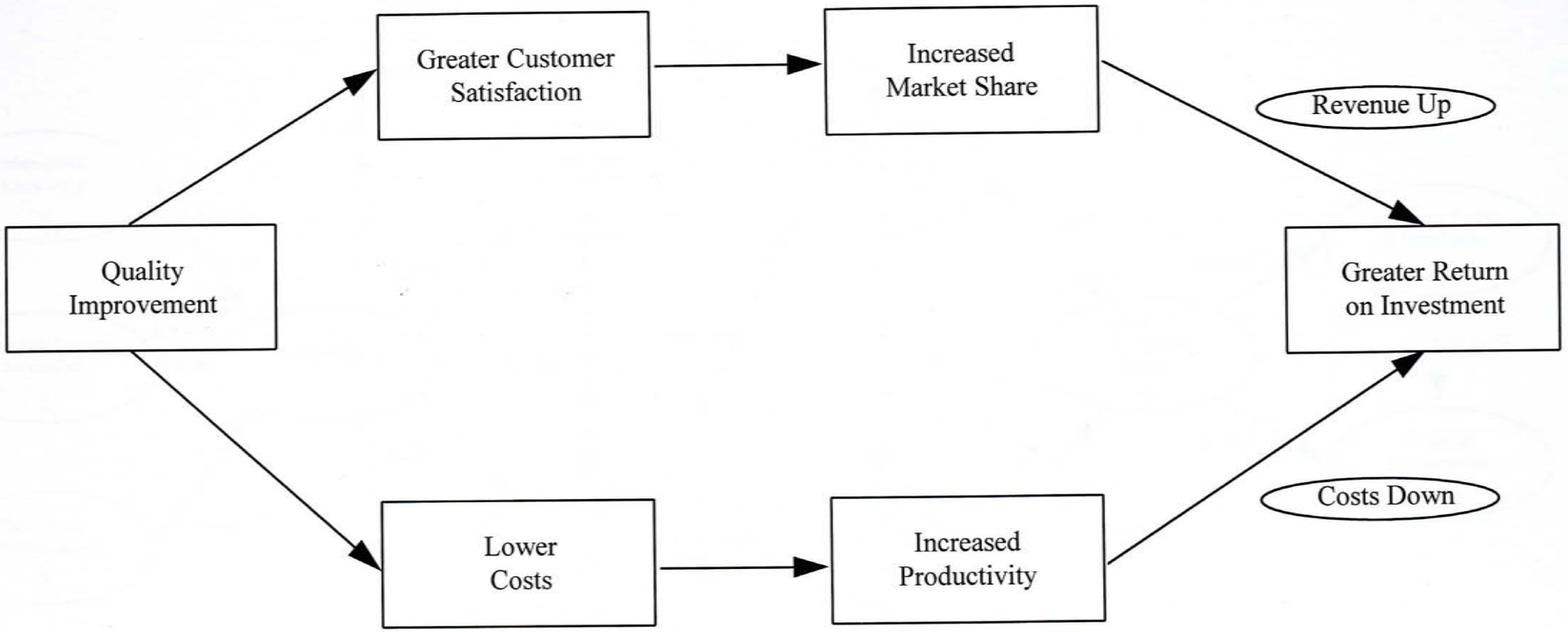


Figure 2: The Deming Chain Reaction



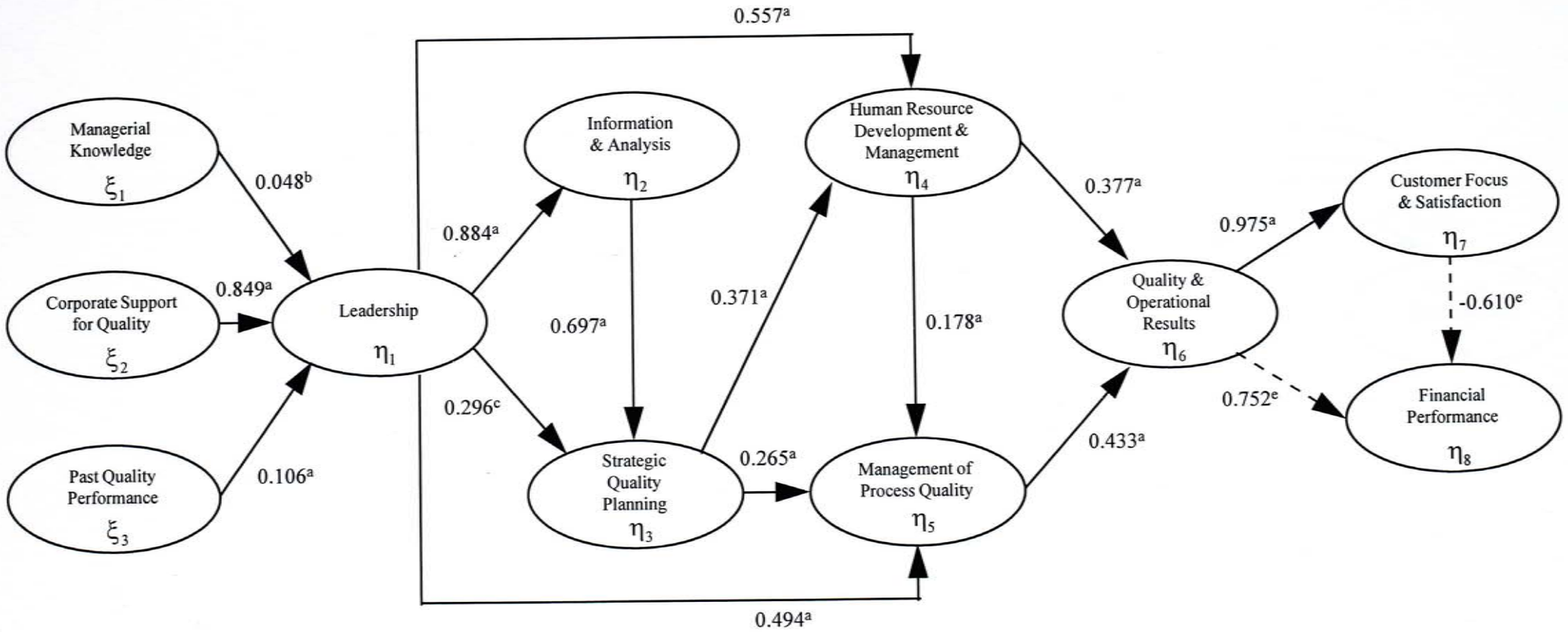
Source: Deming, W. E., "Quality, Productivity, and Competitive position", Cambridge, MA: Massachusetts Institute of Technology, Centre for Advanced Study, 1982

Figure 3: Garvin's Cost Savings Model



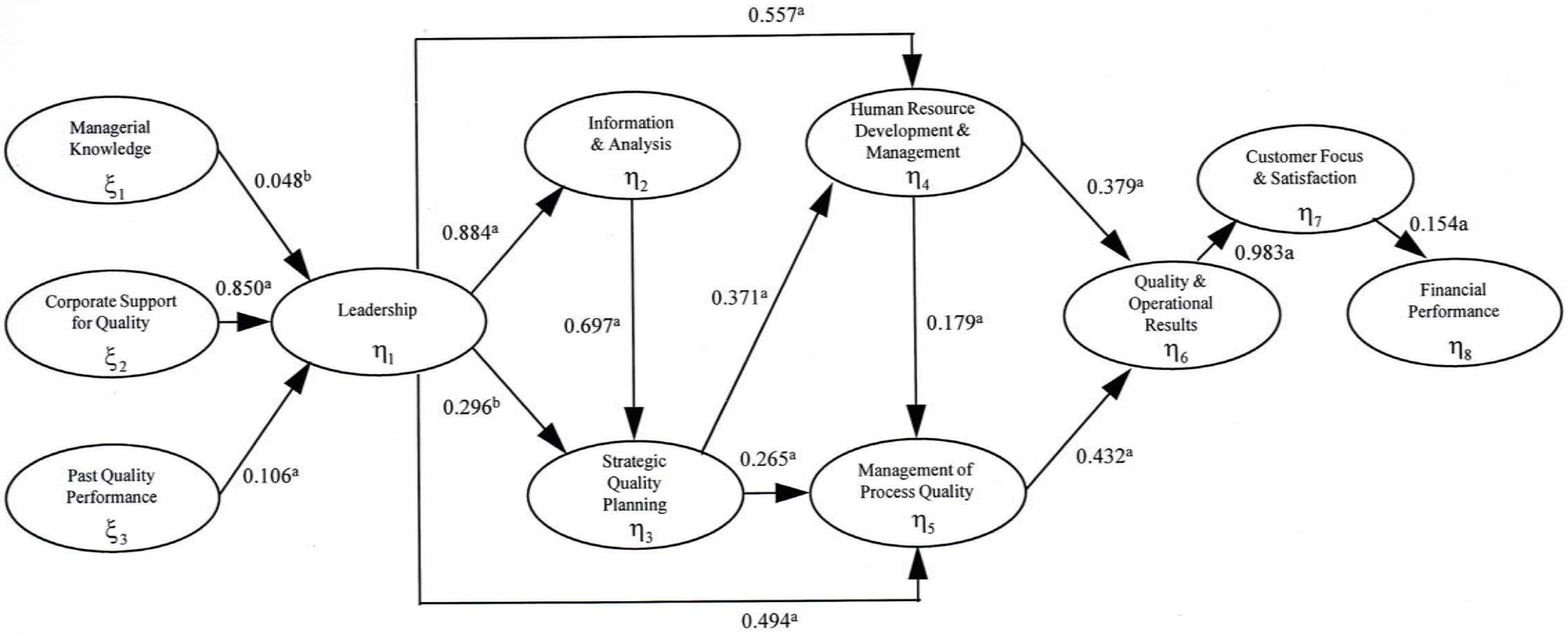
Source: Garvin, D. A., "Product Quality: An Important Strategic Weapon", Business Horizons, 27, 3, 1984, pp.40-43.

Figure 4: Path Diagram and Standardized Path Coefficients of the Total Quality Management Model



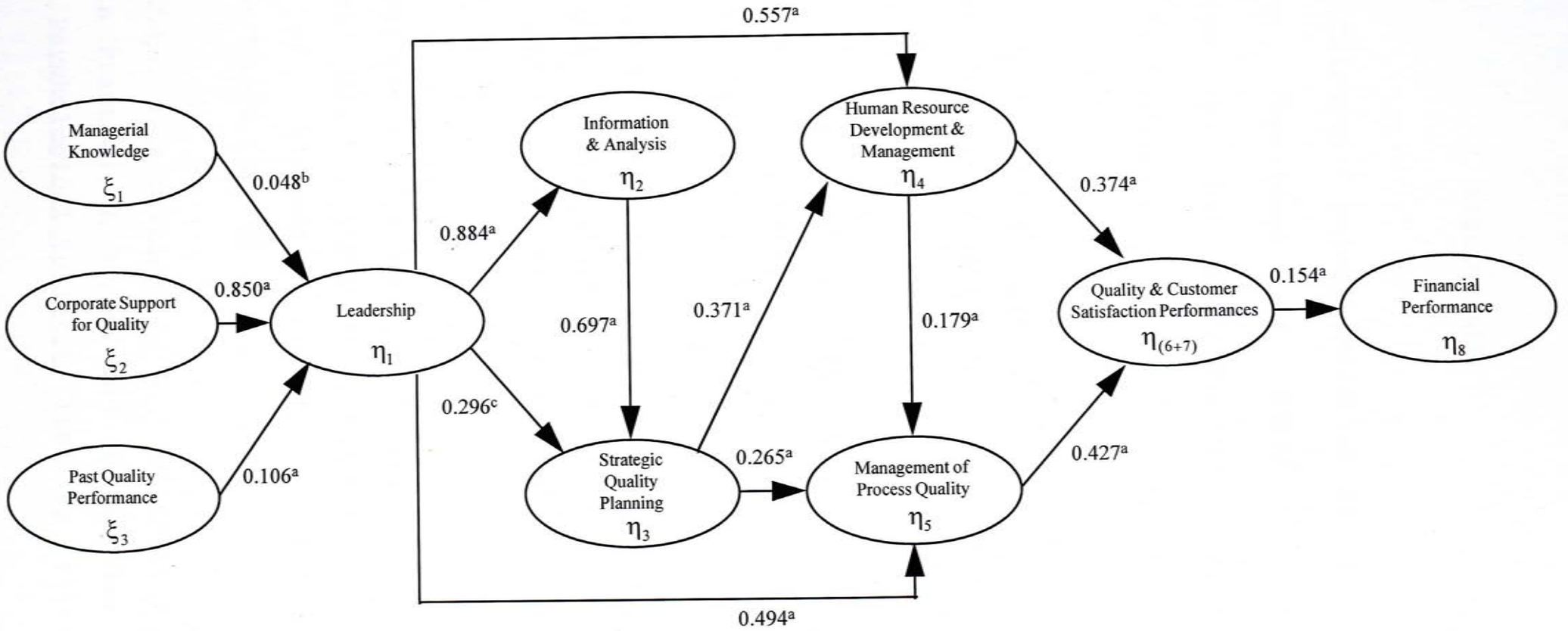
Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Figure 5: Path Diagram and Standardized Path Coefficients of the Reformulated Total Quality Management Model (First Alternative)



Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

Figure 6: Path Diagram and Standardized Path Coefficients of the Reformulated Total Quality Management Model (Second Alternative)



Note: $p^a < 0.005$ $p^b < 0.01$ $p^c < 0.05$ $p^d < 0.1$ $p^e > 0.1$

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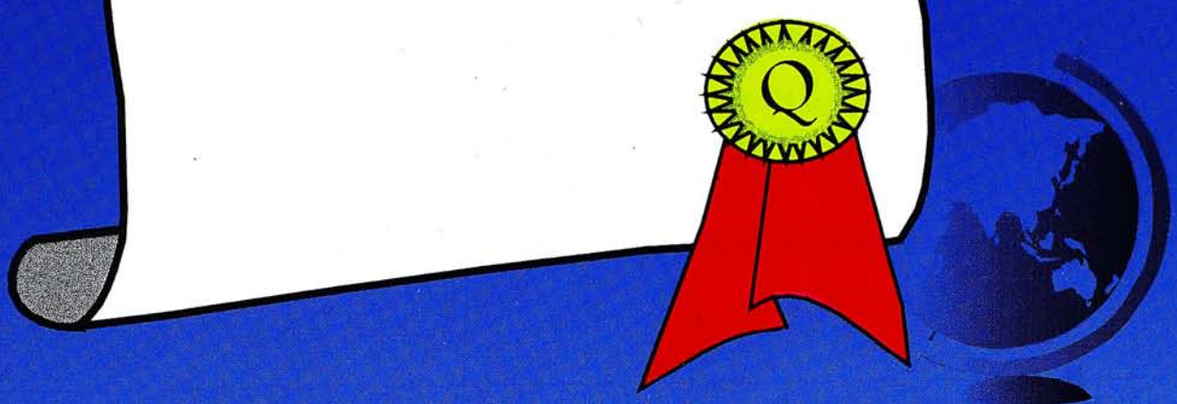
APPENDIX

A Sample of the Research Questionnaire

Hong Kong Quality Improvement Practices Survey



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The Hong Kong Trade Development Council

Vocational
TRAINING COUNCIL
職業訓練局

Vocational Training Council Tower, 27 Wood Road, Wanchai, Hong Kong. 香港灣仔活道二十七號職業訓練局大樓

11th March 1996

Dear Sir,

Survey on Quality Improvement Practices in Hong Kong

A group of part-time MBA and full-time M. Phil students from the Chinese University of Hong Kong will be conducting a survey to assess the quality improvement practices adopted by Hong Kong firms.

The Council has agreed to offer its assistance to make the survey a success. In this connection, I attach herewith for your completion a set of survey questionnaire and should be grateful if you woud kindly return the completed questionnaire to Mr. Dominic Chan, the Study Co-ordinator, using the attached envelope at your earliest convenience.

The information collected will be handled in strict confidence.

I look forward to your kind co-operation in furnishing the required information. Should you have any queries in connection with the questionnaire, please feel free to contact Mr. Dominic Chan at Tel. 2609 8561.

Yours faithfully,

(S.P. Fu)
for Executive Director

HKQAA
HONG KONG QUALITY ASSURANCE AGENCY
ISO 9000 / 14000 QUALITY AND ENVIRONMENTAL MANAGEMENT SYSTEMS CERTIFICATION BODY

香港品質保證局

HONG KONG QUALITY ASSURANCE AGENCY
1/F HKPC BUILDING, 78 TAT CHEE AVENUE,
KOWLOON, HONG KONG.
Telephone: (852) 2788 5333 Facsimile: (852) 2788 5322

27th February, 1996

TO WHOM IT MAY CONCERN

A group of part-time MBA and full-time M. Phil students from the Chinese University of Hong Kong will be conducting a very extensive survey to assess the quality improvement practice on firm performance in Hong Kong industries. The objective of this study is to provide answer to the following questions:

a. Do quality practices actually enable firms to achieve higher quality, operating and financial performance ?
b. What are the quality approaches that improve firm performance ?

This study is conducted under the supervision of Dr. T. S. Lee, who is the Senior Lecturer of the Business Faculty. Mr. Dominic Chan is the study co-ordinator for this survey.

As this study will be beneficial to the development and enhancement of quality management practices in Hong Kong, therefore, we are writing to ask for your generous support for Mr. Chan and Dr. Lee to make their survey a success.

Thank you for your kind attention.

Yours faithfully,
HONG KONG QUALITY ASSURANCE AGENCY

Kelvin Siu
Controller
Business Development

You Are Invited

Dear Manager/Director,

We sincerely invite you to participate in one of the most prestigious studies of Quality Improvement Practices in Hong Kong. By spending 30 minutes to complete this questionnaire, you will contribute to the success of this study and more importantly, the quality advancement of Hong Kong.

It is not necessary to disclose your company's identity. The data collected will be strictly kept confidential and solely used for academic purpose.

Benefits to You

- A summary of the findings and the trend of quality improvement in Hong Kong industries would be made available to you. Please fill in your contact address on the return envelope provided if you wish to receive a copy.

- A seminar could be arranged to explain the findings and the managerial implications of this survey provided that you mail out the questionnaire in one week's time on receipt of it. Please send in your business card along with this questionnaire so that we can contact you for reservation.

Instructions in Filling the Questionnaire

- This survey seeks to identify your company's approach and achievements regarding quality.

- Please provide answers that best describe your company's current policies, practices, and in a few instances actual performance in your company.

- You may answer the questions for your division only, but please be consistent in answering all the questions with respect to whether you are referring to the whole company or just your division.

- In case of questions, please feel free to call Mr. Dominic Chan at Tel: 2609-8561 or Fax: 2603-6840.

Part I Company/Division Demographics

1) The nature of our company's products or services is
   1. Manufacturing
   2. Service
   3. Both manufacturing and service

2) My company/division belongs to
   1. Private company.....Go to question 3
   2. Government department.....Go to question 4

3) The type of products or services in our company is
   1. Primary production
   2. Food, beverages and tobacco
   3. Wearing apparel
   4. Textiles
   5. Furniture and household goods
   6. Paper products and printing
   7. Chemical products
   8. Rubber and plastic products
   9. Non-metallic mineral products
   10. Metal products
   11. Electrical and electronic products
   12. Office, accounting and computing machinery
   13. Machinery, equipment and apparatus
   14. Precious instrument, clocks and watches, optical goods
   15. Wholesale, retail and import/export trades
   16. Tourism, restaurants and hotels, catering
   17. Community, social and personal services
   18. Finance, insurance, real estate and other business services
   19. Transport, storage and communication
   20. Construction
   21. Professional services
   22. Others Please specify:_____

4) My company/division has been in business for approximately _____ years.

5) The number of employees in my company/division is approximately _____.

6) The annual employee turnover rate for my company/division last year was _____ %.

7) Company/division sales last year were approximately HK$ _____.

	Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
8) I am familiar with various quality programs such as zero defects, quality circles, statistical process control, etc.	1	2	3	4	5	6	7	8	9
9) I have read books and articles, attended seminars, or sought outside expertise or consultants in the quality area	1	2	3	4	5	6	7	8	9
10) Overall, my knowledge and experience in the quality area is comparable to that of managers at similar levels in other companies	1	2	3	4	5	6	7	8	9

11) My job title is
   1. General manager
   2. Division manager
   3. Quality Manager
   4. HR manager
   5. Executive
   6. Supervisor
   7. Officer
   8. Others
      Please specify:_____

Part II Quality Improvement Techniques

1) Does your company currently has a separate quality department?
   1. Yes..... Go to question 2
   2. No..... Go to question 3

2) a) The quality department has established for about _____ years.
   b) Currently it has approximately _____ staffs.

3) Is your company/division certified as an ISO 9000 producer?
   1. Yes..... Go to question 4
   2. No..... Go to question 5

4) a) Our company/division has received the certificate of
   1. ISO 9001
   2. ISO 9002
   3. ISO 9003
   b) Our company/division has received the certificate for _____ years.

The *Organizational Quality Policy* in my company/division is best described as:

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
5)	Setting corporate goal in quality	1	2	3	4	5	6	7	8	9
6)	Rewarding corporate management for quality performance	1	2	3	4	5	6	7	8	9
7)	Having adequate corporate leadership for quality	1	2	3	4	5	6	7	8	9
8)	Considering quality as a key strategic opportunity by corporate management	1	2	3	4	5	6	7	8	9
9)	Emphasizing corporate quality throughout the organization	1	2	3	4	5	6	7	8	9
10)	Corporate management committed to quality	1	2	3	4	5	6	7	8	9
11)	Having progressive and innovative management	1	2	3	4	5	6	7	8	9
12)	Providing adequate resources to corporate management for quality improvement purpose	1	2	3	4	5	6	7	8	9
13)	Having appropriate corporate system, e.g. plants, equipment, systems for quality improvement purpose	1	2	3	4	5	6	7	8	9

Quality Improvement in our company is best described as including the following practices:

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
14)	Top management assumes responsibility for quality performance	1	2	3	4	5	6	7	8	9
15)	Top management is evaluated for quality performance	1	2	3	4	5	6	7	8	9
16)	Major department heads participate actively in quality improvement process	1	2	3	4	5	6	7	8	9
17)	Top management has clear and specific goal and objectives for quality performance	1	2	3	4	5	6	7	8	9
18)	Top management creates and sustains clear and visible quality values	1	2	3	4	5	6	7	8	9
19)	Top management communicates quality goal and objectives throughout the organization	1	2	3	4	5	6	7	8	9
20)	Adequate amount of review of quality issues in top management meetings	1	2	3	4	5	6	7	8	9
21)	Management concerns about public responsibility	1	2	3	4	5	6	7	8	9
22)	Quality data and information are collected and managed regularly and systematically	1	2	3	4	5	6	7	8	9
23)	Quality data and information are accessible to employees	1	2	3	4	5	6	7	8	9
24)	Quality related competitive comparison and benchmarking are used for quality planning, evaluation and improvement	1	2	3	4	5	6	7	8	9
25)	Quality data and information are analyzed and used as tools to manage quality	1	2	3	4	5	6	7	8	9
26)	A strategic quality planning process addresses in detail how the company will pursue market leadership through providing superior quality products/services	1	2	3	4	5	6	7	8	9
27)	Quality plan and goal are comprehensive within the organization	1	2	3	4	5	6	7	8	9
28)	Employees contribute effectively in employee involvement programs such as quality circle	1	2	3	4	5	6	7	8	9
29)	Employees are responsible in producing quality products/services	1	2	3	4	5	6	7	8	9

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
30)	Constant awareness of the importance of quality among employees	1	2	3	4	5	6	7	8	9
31)	Employees participate in quality decisions	1	2	3	4	5	6	7	8	9
32)	Providing specific work-skills training and quality education for employees to meet the quality objectives associated with their responsibilities	1	2	3	4	5	6	7	8	9
33)	Employees receive training in the "total quality concept", i.e. the philosophy of company-wide responsibility for quality	1	2	3	4	5	6	7	8	9
34)	Providing team building and group dynamics training for employees	1	2	3	4	5	6	7	8	9
35)	Training employees basic statistical process control techniques	1	2	3	4	5	6	7	8	9
36)	Adequate resources (staffs, system, facilities, funding) are available for employee training	1	2	3	4	5	6	7	8	9
37)	Employees receive feedback on their quality performance	1	2	3	4	5	6	7	8	9
38)	Employees are recognized for superior quality performance	1	2	3	4	5	6	7	8	9
39)	Employees are provided with a comfortable working environment	1	2	3	4	5	6	7	8	9
40)	Overall, employees are satisfied with the company	1	2	3	4	5	6	7	8	9
41)	Quality practice reflects an emphasis upon design	1	2	3	4	5	6	7	8	9
42)	Quality practice reflects an emphasis upon conformance	1	2	3	4	5	6	7	8	9
43)	Design, manufacturing and other affected departments work closely together in the product/service development process	1	2	3	4	5	6	7	8	9
44)	New products/services design are thoroughly reviewed before introduction	1	2	3	4	5	6	7	8	9
45)	Specifications and procedures of products/services are clearly stated	1	2	3	4	5	6	7	8	9

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
46)	Acceptance sampling and inspection are used to ensure conformance	1	2	3	4	5	6	7	8	9
47)	Employing statistical process control to control processes	1	2	3	4	5	6	7	8	9
48)	Preventive equipment maintenance are carried out to guarantee stable work schedule	1	2	3	4	5	6	7	8	9
49)	Production process is highly automated	1	2	3	4	5	6	7	8	9
50)	Workers perform self-inspection of their works	1	2	3	4	5	6	7	8	9
51)	Various quality related tests, e.g. reliability, feasibility and liability tests are performed to assess quality and safety of products/services	1	2	3	4	5	6	7	8	9
52)	Quality is emphasized and considered as salable attribute	1	2	3	4	5	6	7	8	9
53)	Devote effort to achieve continuous improvement of processes	1	2	3	4	5	6	7	8	9
54)	Instruction manual on production process are well documented and distributed to employees	1	2	3	4	5	6	7	8	9
55)	Process design is "fool-proof" to minimize the chances of employee errors	1	2	3	4	5	6	7	8	9
56)	Production process is well supported by periphery functions	1	2	3	4	5	6	7	8	9
57)	Suppliers are involved in the product development process	1	2	3	4	5	6	7	8	9
58)	Suppliers are rated and selected based on quality rather than price	1	2	3	4	5	6	7	8	9
59)	Reliance on reasonably few dependable suppliers	1	2	3	4	5	6	7	8	9
60)	Long-term contract and commitment are offered to suppliers	1	2	3	4	5	6	7	8	9
61)	Technical assistance and education are provided to suppliers	1	2	3	4	5	6	7	8	9

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
62)	Quality department can have direct access to top management	1	2	3	4	5	6	7	8	9
63)	Quality department coordinates well with other departments	1	2	3	4	5	6	7	8	9
64)	Quality staff professionals are utilized as a consulting resource	1	2	3	4	5	6	7	8	9
65)	Quality department is effective in improving quality	1	2	3	4	5	6	7	8	9
66)	Customers' opinions and views regarding their needs and requirements are actively sought	1	2	3	4	5	6	7	8	9
67)	Customer relationship and customer complaints are handled cautiously	1	2	3	4	5	6	7	8	9
68)	Customers regularly and formally receive customer satisfaction questionnaires	1	2	3	4	5	6	7	8	9
69)	Customer satisfaction and service standards are compared with other companies in the same industry	1	2	3	4	5	6	7	8	9

Part III Company/Division Performance

In general, our customers

		Strongly Agree	Agree	Slightly Agree	Neither Agree Nor Disagree	Slightly Disagree	Disagree	Strongly Disagree	Don't Know	Not Relevant
1)	Demand quality	1	2	3	4	5	6	7	8	9
2)	Perceived my company's/division's quality performance over the past three years as favorable	1	2	3	4	5	6	7	8	9
3)	Are satisfied with my company's/division's quality performance over the past three years	1	2	3	4	5	6	7	8	9

In our industry,

4)	The degree of competition faced by my company/division is high	1	2	3	4	5	6	7	8	9
5)	There is little barrier of entry into business	1	2	3	4	5	6	7	8	9

Quality performance can be measured or expressed in a number of ways. In my company/division, over the past year, the

6) Percent of items (or services) defective in our processes averaged _____ %.

7) Internal waste/scrap cost as a percent of dollar sales was _____ %.

8) Returns and warranty or adjustment costs as a percent of dollar sales was _____ %.

9) Rework as a percent of dollar sales was _____ %.

10) Training and development expenditures as a percent of dollar sales was _____ %.

Similar to quality, *financial performance* can be measured in a number of ways. In my company/division,

11) Last year's net profit as a percent of dollar sales was _____ %. (Negative for loss)

12) The past three years' net profit as a percent of dollar sales was _____ %. (Negative for loss)

13) Last year's return on asset, i.e. , net profit divided by assets, was _____ %. (Negative for loss)

14) The past three years' return on asset, i.e. , net profit divided by assets, was _____ %. (Negative for loss)

15) Last year's average percent sales growth was _____ %. (Negative for sales decline)

16) The past three years' average percent sales growth was _____ %. (Negative for sales decline)

Thank you for your cooperation. Your input is very much appreciated.
Please mail out the questionnaire as soon as possible for reservation of seminar .

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As always, I retain responsibility for all errors and would greatly appreciate any comments on this questionnaire.

Dominic C. W. Chan

This study is dedicated to all who are devoted to continuous quality improvement in Hong Kong. It is my sincere wish that this study will provide benefits to both the academic research and industrial development. Through identification of the characteristics of quality improvement practices in Hong Kong, I hope that Hong Kong companies can share the successful factors of the quality leaders in their industries. The findings of this study will also serve as a confirmatory study to previous quality related works and an empirical evidence to encourage Hong Kong managers to pursue better quality and higher productivity. This, I hope, will be my modest contribution to the prosperity of Hong Kong.